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EDITORIAL NOTES.

As Mysterious as Ever.

The position occupied by the General Electric Company in the financial world is as mysterious to-day as it was when the stock was selling above par and the bonds were eagerly sought for by Wall Street and State Street investors.

The insiders who have so successfully manipulated the stock to their own profit are still in full control of the situation, and run the stock up and down within a narrow margin almost at will. The outsiders still hold on to their bad investment with a pertinacity that does little credit to their judgment.

The condition of the company, notwith standing all reports to the contrary, goes from bad to worse with each succeeding week, and there is little doubt that the next twelve months will see the end of the inglorious and futile attempt to continue it as a factor in the electrical business.

ELECTRICITY'S statement as to the direct losses of the company by the Ft. Wayne withdrawal have been questioned. The amount named by us, however, was below, rather than above, the actual figures. The direct debt is carried on the books at Schenectady at something over $1,000,000, instead of $500,000 as reported in these columns. We placed the debt at the amount we were informed the claim was valued at in making up the last annual statement—fifty cents on the dollar.

The entire sum is a total loss.

The sale of treasury assets continues, and with the proceeds the manipulators are enabled to make a showing which may deceive the superficial observer but not those who are posted as to the actual facts. Thus the debts have been reduced, and the excess of running expenses over profits made good temporarily. The sale of goods for less than cost continues, giving the company's works the appearance of prosperity when in reality the business taken merely hastens the ultimate and inevitable collapse.

The treasury is now nearly empty of salable securities, and unless some miracle occurs to change the present course of events, the company will run into debt again with rapidity when the last of these securities have been sold.

Dealers in the stock seem to forget that the company's capital is now impaired about $16,000,000, that no dividends can be paid until this impairment is corrected, and that the suspended dividends on the preferred stock must all be paid before the common shareholders can receive one dollar of dividends, even though the company were able at some time in the future, as in the past, to borrow the money with which to pay a dividend.

Twenty years is a conservative estimate of the time which would be required, even with good business, for them to earn enough to make good the impaired capital.

Meantime the competing companies in the field are securing all the contracts worth having.

There has been no time in the past year when the outlook for the concern was as gloomy as to-day, when the hopes of the independent manufacturers for riddance from the competition of the unfair and dishonest conglomeration were so bright. ELECTRICITY does not desire to take too much credit to itself for bringing confusion upon the unholy combination, but it is a legitimate source of pride to us that we were at least six months in advance of any other journal in America in correctly estimating the impossibility of the success of the scheme, and that we have done at least our share in averting the disaster which that success would have caused to every honorable concern in the trade.

When General Electric was selling above 115, we prophesied that it would yet sell below 50, and now, with the constantly decreasing prospects for prolonging the life of the concern, we place upon record our prophecy that it will sell below 10.

And at the latter figure shareholders would get more than actual value for their holdings.

……o……

MR. COFFIN'S fortune is now estimated by those who ought to know at between $400,000 and $500,000. This is a decided shrinkage from the four millions he was credited with two years ago.

The Fight Must Continue. We have received an interesting communication this week, too long to reproduce, taking us to task for prolonging our fight against the General Electric Company, now that the company seems to be, according to our correspondent's views, practically dead, no longer possessing the power to injure the trade.

If we believed that the company no longer possessed the power to injure the trade, there would be little ground left for an argument as to the advisability of ceasing our campaign against it. But we believe nothing of the kind.

We do not exaggerate, we hope, when we say that ELECTRICITY's knowledge of the plans and inside workings of the sham Trust has been proved to be accurate, our prophecies and statements of fact having, without exception, been borne out to the letter by subsequent developments.

From what we know, and have already reported in these columns, as to the future plans of the company, we can see no reason for granting them immunity from criticism, or for withholding restatements of their infamous conduct in the past. We have shown conclusively, we think, that the consolidation scheme was built upon deceit and misrepresentation, and was carried out with direct intent to defraud the purchasers of the company's securities; that the policy of the company, if successful, was such as to cause irreparable injury to the electrical industry of the country, and that the injury resulting from this policy, even though it has proved a disastrous failure, has been widespread and severe, bringing hardship and misfortune upon scores and hundreds of active and deserving workers in the trade.

If now there were any reason to suppose that a change has taken place in that policy, there might be some sense in suspending criticism, in allowing the dying days of the gigantic humbug to be as peaceful as possible. Unfortunately, there is no reason for supposing anything of the kind. Our information as to the inside plans of the company is as exact to-day as it was two years ago. There have been no changes save those forced upon the directors by financial troubles; no changes of judgment as to the correct method for conducting an electrical stockjobbing enterprise with the manufacturing feature of the business as a side show. There has been no cessation in the campaign of blackmailing patent litigation, no reversal of the unjust policy towards legitimate competitors which has disgraced the company from the start.

Until there shall be important and vital changes on these lines in the conduct of the company's affairs, ELECTRICITY will continue to regard the sham Trust as a public enemy and to treat it accordingly.

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WE congratulate Messrs. Russell & Elder, the San Francisco agents of the Westinghouse Company, on the splendid business they are doing. They are evidently making their old friend, Dr. Addison, very tired.

Some More New Units. Our friend Frank L. Pope publishes a paper up in the Berkshire Hills—and a real good paper it is, too, although it is not an electrical paper—and his brother, Ralph W., sometimes contributes to its columns, and his contributions are interesting, as Ralph W.'s articles always are. Not long since he contributed an article on the planked-shad dinner given by the Institute at Gloucester during the Philadelphia meeting, which, next to the shad dinner itself, was one of the best things we have run against in a long while. In his article he describes the manner of planking shad and uses the expression "you take a shad-length of board," etc., thus introducing a new unit of length. This is likely to lead to confusion, and we doubt if it will come into general use, for supposing a man were ordering lumber for his own coffin and said that he wanted so many shad-lengths of board, the coffin might not fit when it was made—for there are shad and shad and there are little ones and big ones. One would therefore have to be more specific in his order. Thus Ralph W., for instance, in writing his order would have to specify big shad-lengths and George Phelps be particular to write "little shad-lengths." The unit, however, has one recommendation, viz., its flexibility. Thus it might be stipulated that the size of the shad which was to be used as the unit should vary inversely as the price of lumber; then a shad-length of lumber would have an invariable price. To be sure we would be compelled to use more shad-lengths for any given purpose when lumber was high than when it was low, but that would be nothing compared with the convenience of always knowing what a shad-length was worth.

In the Chinook dialect, we understand, there is a unit of length or distance called the "si-yah," after which we might well copy in electrical nomenclature. If you wish to inquire the distance to any place, if it is not very far the Chinook will say "si-yah." If it is somewhat further, he will say siya-ah; if still further, siya-a-ah, with a circumflex modulation of the voice approaching a true sine curve. Now the ampere turn is a very useful expression, but it is very indefinite as to the length of wire involved. On a very large magnet, if a very small current be used, it may mean three or four feet of wire, whereas on a small magnet with a big current it might not amount to more than a small fraction of an inch. Now we suggest that some other term be substituted which will always indicate the length of wire in an ampere turn. Shad-length might do, but si-yah would be better on account of its greater flexibility. Thus where the length was *very* short it could be designated by si-yah with a crisp modulation. As it grew longer the crisp would gradually give place to a rounded peak, and so on until when it became a shad-length the modulation might be a true sine curve, and multiples of shad-lengths might be designated by additional *ahs*. An additional advantage of this nomenclature would be its adaptability to alternating currents on account of the sine wave character of the modulation, and since in practice a true sine wave is never attained, the expert electrician might so modul his voice as to indicate exactly the shape of wave passing through the wire. We respectfu submit these suggestions to the Committee Units and Standards of the Institute for th serious consideration, and also to Messrs. Ho ton, Kennelly and Ralph W.

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MR. E. I. GARFIELD, who was secretary of Thomson-Houston Company for many yea and who held a similar position with the G. Company until crowded out by Mr. Coffi former stenographer, Westover, will proba have charge of the New England business of Ft. Wayne Electric Corporation It is m and more apparent that Mr. McDonald has c ried with him the financial backing and sympathy of the T.-H. coterie.

......o......

THE LATEST Trust to come to grief is Umbrella Trust, for which a receivership been asked. They could not make enough u brellas to keep themselves out of the wet. Th is sound sense in the words of Mr. Sam U termyer, counsel for the Trust:

"The fate of this company again illustra the fact that the economic laws of business w take care of and regulate these combinations capital far better than legislation looking their suppression. If by combination the pro uct can be furnished to the consumer m cheaply than could be done by the outside the combination will succeed, and if it cannot this it is sure to fail. These combinations ha against them the important element of a lack intense individual interest, and they have to c tend with the existence of that interest in th competitors. People need never fear these gregations of capital, for their failure or succ depends on whether they eventually injure benefit the public."

It will not be many months, we predict, bef Mr. F. P. Fish will be called upon by some e terprising reporter for his explanation of collapse of another Trust. We wonder if M Fish will show equal wisdom. Will he be wi ing to admit that the General Electric Compa has failed because it was an injury, not a benef to the public?

......o......

IT IS a fact, and not at all surprising, that t fellow, Westover, who succeeded in getting hi self made secretary of the G. E. Compa through his knowledge of Mr. Coffin's pecul "business" methods, has now turned against creator, and is doing all in his power to d credit Mr. Coffin with his associates. Such the penalty of dishonor. Mr. Coffin ought have known better. Surely the lesson had be taught often enough that the man who will dishonorable and illegal service for one e ployer will use the information thus gained his own personal advantage whenever the ti seems opportune for so doing.

......o......

IF the record of Drexel, Morgan & Co pany's transactions in G. E. stock were ma public, it would create a sensation, and we fe would still further weaken that concern's ho on public confidence. They have proven the selves masters of the game at which the Bost nians were only novices. But it is after all very disreputable game.

Modern Electro-Chemical Theory and Its Bearing Upon the Practice of the Future.

BY DR. OSTWALD.*

Electro-chemistry has been somewhat behindhand in the general development of technical knowledge, chiefly because electricians have been hitherto chiefly concerned in the evolution of purely mechanical appliances; a meeting place of science and electrical technology is provided by those electrolytic problems which are now of especial interest. The present time is well fitted for investigation of this kind. The century-old problem of the voltaic couple is in process of solution. We are now in the possession of sufficient knowledge to calculate the E. M. F. of a given couple with a high degree of approximation, and our information concerning electrical conduction is also considerable. The modern dissociation theory of solution must be invoked to provide a satisfactory explanation, and in this particular instance its electrical rather than its chemical aspect may be profitably considered. Taking the case of a dilute solution of sodium chloride in water—e. g., 0·5 grm. per litre—it is found that such a solution is a good conductor. Adopting the view that conduction depends on the translation of electrical charges by ions, it is clear that with sodium chloride of the strength given, sodium ions act as carriers of positive electricity and chlorine ions of negative electricity. This solution being dilute, the distance separating any given ion from another of the same kind is comparatively great, whence it follows that the period during which an ion—e. g., of sodium—exists alone in the watery solution, is greater than that passed by it in the combined state. On grounds of the kind thus indicated, it becomes possible to calculate what fraction of a given electrolyte is split up into ions. The conditions determining the electrical conductivity of a solution admit of simple definition. In every electrolyte the conductivity is proportional to the number of ions per unit volume, and also to two constants—the velocities of migration of the ions differing in kind. This velocity is greatest in the case of hydrogen, whence it follows that acids are the best conductors in solution. The question of the conditions governing E. M. F. is, however, of still greater moment than that relating to conductivity, and may be dealt with in a similar manner.

The starting point for reasoning on this subject consists in a full appreciation of the nature of osmotic pressure, which may be stated thus: When a concentrated aqueous solution is covered by a layer of water, diffusion takes place until the concentration is uniform. The cause of movement from one layer to the other has the character of a pressure, and is termed osmotic pressure. To prove the existence of this pressure it is only necessary to oppose the movement of the dissolved substance, which can be done by interposing a septum between the two layers which is pervious to water but not to the substance in solution. A septum of this kind has been devised by Pfeffer†, and by its means osmotic pressure has been shown actually to exist, and to be of considerable magnitude. Thus a solution such as sea-water gives a pressure of about twenty atmospheres. The origin of this pressure is still unknown, but its existence is certain, and obtains for all soluble substances. By surrounding a solution with an osmotic septum strong enough to resist the pressure, a maximum osmotic pressure is obtained, which is dependent on the solubility of the substance in solution, and cannot be exceeded. This pressure is perfectly analogous to steam pressure, and just as steam pressure may be used to drive an engine, so can osmotic pressure be caused to drive a corresponding machine. A galvanic cell is nothing more than a machine driven by osmotic pressure.

In order to understand this fully, the process of solution which a metal undergoes when used in a galvanic cell must be studied somewhat closely. In an ordinary Daniell cell, zinc dissolves to form zinc sulphate; this, stated in dissociation language, means that zinc ions electrically charged are formed from the metal in the massive unelectrical condition. A corresponding number of copper ions are translated from their electrically-charged condition to that of the ordinary metal. At the zinc electrode positive electricity is continually received, and at the copper electrode it is given up. The conductive connection of the two electrodes determines the simultaneous occurrence of a chemical and electrical change, neither of which takes place without the other. The analogy between pressure and E. M. F. is now complete. Just as an engine can be driven by means of two fluids of different pressure, so can an electrical cell be operated by two sources of different electrical pressure. The zinc and copper of a Daniell cell are two such sources, and the difference of their electrical pressure depends on the difference of osmotic pressure due to the zinc on one side and the copper on the other. The higher the pressure arising from the zinc and the lower that to be overcome at the copper electrode, the better the cell works and the greater is its E. M. F.

The pressure measuring the endeavor of a metal to go into solution, or the "solution-pressure," as it may be termed, is of perfectly definite magnitude for every metal, and it appears at first sight as if it simply depends on the nature of the metal in the cell and on no other factor. That there is another factor becomes apparent from the following considerations: When the zinc electrode is in contact with the solution, the effective solution pressure depends not only on the zinc but also on the zinc ions present in the solution which exercise a counter pressure. The excess of the first above the second is the effective solution-pressure. The E. M. F due to the zinc is therefore the greater the smaller the counter-pressure of the ions, i. e., the lower the concentration of the solution in respect of its content of zinc ions. As a matter of fact the E. M. F. of a Daniell cell is greater when sulphuric acid is in contact with the zinc than when zinc sulphate is used. The converse holds in the case of the copper electrode where it is desirable that the concentration of the liquid in respect of copper ions should be at its maximum, in order that the pressure exerted by those ions may aid the deposition of copper in the ordinary metallic state. This, then, is a simple exposition, quantitative in character, comparable with the Newtonian law of gravitation of the theory of the galvanic cell. The theory gives definite conclusions for definite cases, and those instances in which complete calculation of results from data has not been effected probably arise not from imperfection of the theory, but rather from known mathematical difficulties. Certain constants have also yet to be determined.

The conditions under which the best output from a given cell may be obtained can now be ascertained. On the zinc side a minimum ion pressure must prevail. This is best secured by using a solution in which but few zinc ions are present, even when more or less zinc has been dissolved in it. This is not an impossible requirement, because the whole of a dissolved metal is not necessarily in the form of ions. From this point of view the use of *alkaline* liquids for the zinc (now frequently adopted) has especial significance. The next step consists in combining the use of an alkaline liquid for the zinc electrode with that of an acid liquid as the cathode, in order to obtain the greatest possible E. M. F. It is a consequence of the theory already expounded that the oxidizing agent will act better in an acid liquid, and the reducing agent in an alkaline liquid. Thus, a cell consisting of zinc in caustic potash and carbon in strong nitric acid has an E. M. F. of more than 2.5 volts. Whether it is possible to make such a cell practically available is a question to which it would be premature to reply.

The matters touched upon above become of insignificant importance when compared with a much larger problem, the solution of which must be looked for from the electro-chemist. The low efficiency of the steam engine, as a means for the conversion of the chemical energy of fuel, is not sufficiently widely recognized. In the best cases not more than 10 per cent appears as mechanical work. Now, it may be admitted that the complete conversion of heat into mechanical work cannot be attained; but it is possible to calculate the fraction which can be obtained from a given quantity of heat at a given temperature on allowing the temperature to fall through a known range, and on taking this as a basis it is found that only about one-seventh of the total convertible amount is utilized. The steam engine, regarded as a machine, is not responsible for this state of things, which depends far more on the fact that of the high temperature of the burning fuel (much understated at 1,000° C.) only a small portion is used, namely, that represented by the difference in temperature between the boiler and the condenser. The very large difference of temperature between the furnace and the boiler is not rendered available, and an improvement of the thermo-dynamic machine can only be rendered possible by the use of a higher initial temperature.

But the thermo-dynamic machine is not the only apparatus for the conversion of chemical energy into mechanical work. Should it be possible to obtain the energy of fuel in such a manner that heat as an intermediary would be abolished, the difficulty of having to deal with high temperatures would be overcome and the whole quantity of energy obtained without encountering that inconvenience. The way in which this, the most weighty of all technical questions, can be decided, must be shown by electro-chemistry. Had we a cell in which electrical energy was produced by the direct oxidation of carbon with an output approaching the theoretical, we should be on the brink of an industrial revolution compared with which the invention of the steam engine sinks into insignificance. It is not practicable to foretell the arrangement of a cell of this order, but one point can be insisted on which has been constantly ignored. The energy of a galvanic cell indubitably results from the chemical energy of its components, but complete conversion never occurs. What, then, are the conditions which permit of the maximum efficiency of conversion? The answer is that only *indirect* chemical reactions are electrically useful. The following experiment therefore acquires much significance: Two beakers connected by a filled syphon contain a solution of potassium sulphate. In one is a rod of zinc, in the other one of platinum. On connecting these electrodes with a galvanometer a momentary current passes, and then the needle quickly comes to rest. This, of course, is due to polarization, and in order to obtain a continued current, an acid liquid must be substituted for the original neutral solutions. The question now arises: To which beaker shall an acid (e. g., sulphuric acid) be added? When this is put to most people, the

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*Abstract translation by the London *Electrician* of a paper read before the second annual meeting of the Verbandes der Electrotechniker Deutschlands at Leipzig, June 7-9, 1894, and originally published in the *Electrotechnische Zeitschrift*.

†The septum consists of the colloid cupric ferrocyanide.

reply is : "To the beaker containing the zinc." Actual trial shows, however, that no effect is thus produced, whereas when the acid is added to the liquid in the beaker containing the platinum the galvanometer needle flies to the stop. The apparently paradoxical result is obtained, that the acid must be placed in contact with the metal on which it has no action. This principle is perfectly general in character, and has been demonstrated to hold good in numerous cases. Its necessity is obvious on closer inspection. In order that the zinc may dissolve, ions must be formed and receive their charge of positive electricity. That this may be possible it is requisite that the solution should give up a corresponding amount of positive electricity, i. e., that an equivalent quantity of hydrogen must cease to be in the ion state, and must become converted into hydrogen gas. This giving up of positive electricity from the liquid cannot take place at the point where the zinc dissolves, because the contrary electrical change occurs there. It is therefore only possible for the hydrogen to come off at the cathode, as is actually the case.

It now becomes clear how fallacious was the method by which Jablochkoff sought to obtain electrical energy direct from carbon. He placed the carbon in fused niter, and by its vigorous oxidation obtained a current so feeble that its utilization was not to be thought of. The reason for this failure is as follows : The niter should not be in contact with the oxidizable electrode, but with the electrode which is not attacked by oxidizing substances. A parallel is found in the Bunsen cell where the oxidizing substance (nitric acid) is not placed in contact with the substance to be oxidized (zinc), but with that upon which it has no action (carbon, which is unattacked under these conditions). Similarly the cell of the future (in which carbon is oxidized for the conversion of chemical into electrical energy) will have the oxidizing material at the point where the carbon to be oxidized is not. Such a cell will exhibit exactly the same chemical processes as an ordinary furnace. On one side the carbon will be shovelled in, and on the other oxygen will be admitted, and the product of their indirect interaction will be CO_2. The one essential is a suitable electrolyte to interpose between the carbon and the oxygen, and permit of the occurrence of the electrical interactions, itself suffering no permanent change.

Another problem which will be grappled with in the future by the electro-chemist, is that of the storage of electrical energy by means of secondary cells. The energy stored in a cell is proportional to the quantity that remains in it and to the E. M. F. of the cell. The first is, in its turn, proportional to the electro-chemical equivalent of the material used. This, in the case of a lead accumulator is undesirably great, viz., 103·5. If aluminium, with an electro-chemical equivalent of 9, were available, the weight of the electrodes would be at once reduced to less than $\frac{1}{11}$ of their present amount. It is unlikely that aluminium will prove a practicable substitute, but it is not the only metal with a low electro-chemical equivalent, and something may be achieved by keeping this fact in view.

In conclusion the nature of electrolytic charges may be profitably considered. A conventional distinction between primary and secondary electrolytic changes has sprung up; but it is of little value, and indeed scarcely tenable. On electrolyzing a solution of potassium sulphate the products are not the ions K and SO_4, but hydrogen and caustic potash at the cathode, and oxygen and sulphuric acid at the anode, and these are often called secondary products on the assumption that K and SO_4 are first separated, and immediately act upon the water present, with the result that the substances mentioned above are obtained. But on measuring the E. M. F., which is necessary for this electrolysis, it is found to be smaller than that which would be necessary were it true that the change takes place in the manner conventionally received. The E. M. F. is, in actual fact, of the magnitude demanded by the production of the substances appearing at the anode and the cathode, on the assumption that they are not secondary but are primary products. The principle is perfectly general; the E. M. F. is constantly dependent only on those reactions which actually take place, and is in no way influenced by those arbitrarily termed primary. The distinction between primary and secondary products is therefore of little utility. There is, however, a distinction which is not commonly insisted upon as clearly as is desirable. It is that existing between the substances which are the intermediaries of conduction and those which separate at the electrodes. They are not necessarily identical, and can, indeed, be identical only in a few instances, for only a few ions are capable of passing over into the non-electrical condition without chemical change, as they must if the electrolysis should yield only primary products (using the phrase in its conventional sense).

The distinction which can properly be drawn between primary and secondary products of electrolytic decomposition is foreshadowed by the inquiry : What conducts the current, and what appears at the electrodes? In a few cases the two classes of substances are identical; as, for example, in the electrolysis of fused magnesium chloride, where chlorine and magnesium are evolved; in most instances, on the other hand, wholly different substances appear, and there is no necessity that they should be identical. When such choice of electrolytic products is possible, those substances are always produced whose separation requires a minimum E. M. F. It is wholly indifferent whether they are "primary" or "secondary," i. e., whether they are concerned with the chief part of the conductivity of the electrolyte or not. All the ions present in an electrolyte, each acting according to its number (concentration) and its velocity of migration, come into play in the conduction of the current; for the polarization at the electrodes only the final products of electrolysis have to be regarded. The two things are wholly independent. The matter, though but little regarded, is not of merely theoretical interest, for many errors of practical importance can be traced to want of appreciation of its cogency. In spite of the clearness with which many technical questions can be regarded in the light of scientific investigation, it must not be supposed that the labor of the technical inventor is rendered superfluous. Technical questions must be propounded before they can be answered, and even then the answer may not be forthcoming. The stimulus supplied by such problems is a "valuable consideration" for the help given in response to questions which admit of immediate solution.

Electricity on the D. and H. Canal.

Electricity is used on the Delaware and Hudson Canal for logging and running canal boats. Cables are located along the towpaths, and at certain distances are built sheds in which are placed large numbers of motors ready to go out. On application of the canal-boat captain a motor is allotted to him and he proceeds with his boat, towed with a tow-line by the motor, the lever being operated by reins, or he can work the lever the same as a motorman on an electric street car. When one boat meets another they change motors and proceed. The speed of the boats can readily be regulated, and on this canal recently boats made ten miles an hour without doing any damage whatever to the banks.

Resonance Analysis of Alternating and Polyphase Currents.

BY M. I. PUPIN, PH. D.*

I. INTRODUCTION.

The presence of upper harmonics in an alternating current wave is a fact which deserves careful consideration, both on account of the purely scientific interest which is attached to it, and also on account of the technical bearing of electrical resonance upon the construction of conductors possessing appreciable distributed capacity.

That alternating current and electromotive force waves of a great variety of forms can be produced by properly designing the pole pieces of the field magnet and the iron core of the armature of an alternator is a fact nearly as old as the discovery of electro-magnetic induction. Fully as old is also the knowledge that a great variety of alternating current and electromotive force waves can be obtained by means of the induction of an intermittent current.

A careful investigation of these waves was first made more than forty years ago by Lenz[1] and Koosen,[2] who employed alternators with iron in the armature. They plotted these waves from the instantaneous values of current and electromotive force obtained by means of the now well-known revolving sliding contact. Employing the same method of investigation Joubert[3] showed in 1880 that the electromotive force wave obtained from an eight-pole Siemens alternator without iron in the armature is very nearly a pure sine wave. The method is now known as *Joubert's method of sliding contact.* In 1888, Dr. L. Duncan[4] showed how successfully this method can be employed in the study of alternating current waves produced by commercial machines in actual operation. The same method was considerably elaborated by Prof. H. J. Ryan[5] in an investigation of the action of transformers. The name, "indicator diagram," has been applied to wave curves of current and electromotive force obtained by Joubert's method, and very properly, I think, because they do very clearly indicate the action of alternating current apparatus. The process of taking these indicator diagrams has been shortened very much by Dr. L. Duncan's four dynamometer method.

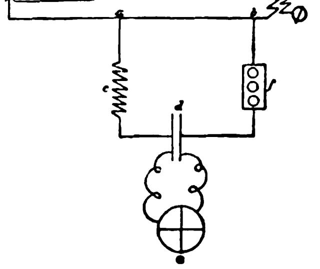

FIG. 1a.

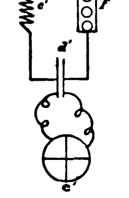

FIG. 1

Our knowledge of the action of alternating current apparatus has been extended considerably by these indicator diagrams.

For instance, we are now much more certain of the limitations which must be imposed upon the simple harmonic wave theory of alternating currents than we were a few years ago, and it looks very much as if progress in this direction, even more than in any other, meant progress towards a complete theory of the working of alternating current apparatus. Hence the desirability of as large a number of workers in this particular region of electrical research as possible.

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* A Paper presented at the Eleventh General Meeting of the American Institute of Electrical Engineers, Philadelphia, May 18, 1894.

[1] Pogg: Ann. 76 p. 494, 1849;—92 p. 123, 1854.

[2] Pogg. Ann. 87 p. 386, 1852.

[3] *Comptes Rendus*, Vol. XCI, p. 161, 1880; Ann. de l'Ecole Super, 10 p. 131, 1881.

[4] See article by Duncan, Hutchinson and Wilkes in the *Electrical World*, March, 1888.

[5] Transactions, Vol. VII, p. 1, Jan., 1890.

There is no doubt that a simpler method would increase this number; for though much must be said in favor of the sliding contact method of obtaining indicator diagrams, yet it must also be acknowledged that the method is a very laborious and uninteresting process of investigation. A great many attempts have been made to devise some optical or some automatic method, but with little success. There is another reason why a new method of studying alternating current waves seems desirable. It is this: The method of sliding contact is not sufficiently sensitive to detect small deviations from a true sine wave, and consequently it is not capable of following up the causes of these deviations when the effects seem to be absent. For instance, the primary current of a transformer can differ very much from a true sine form when the secondary circuit is open, but when a large current is flowing through an approximately non-self-inductive secondary circuit, then the primary can be made to differ inappreciably from a true sine wave. The question arises now, What has become of these causes when the secondary carries a heavy load?

This question is of deep scientific interest; it is also of considerable technical importance. For, if these causes are present at all loads and only hidden by the principal wave, then, considering that these hidden small causes can produce large effects when conditions favoring resonance arise, it is evident that they must be carefully watched and guarded against in the construction of long lines possessing distributed capacity. I do not think that indicator diagrams obtained by the method of sliding contact are capable of giving a definite answer to this important question.

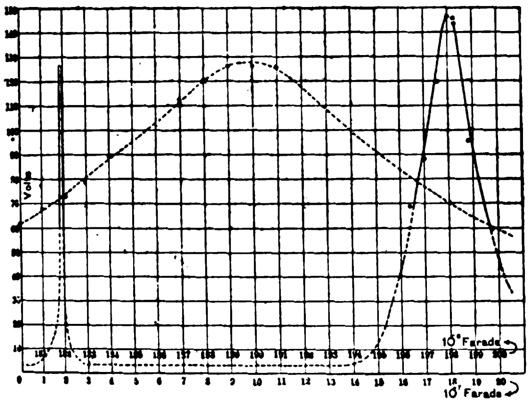

FIG. 2.

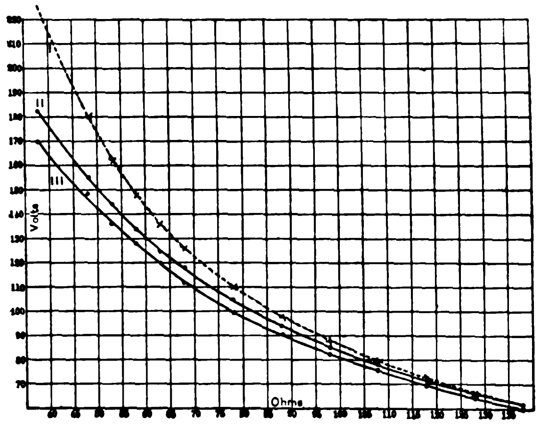

FIG. 3.

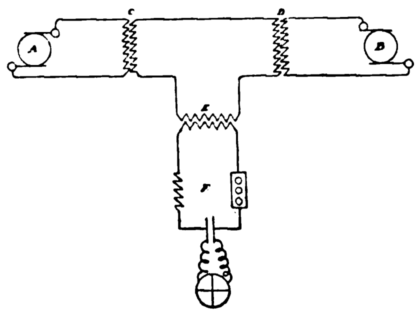

FIG. 4

The method of analyzing alternating current waves by electrical resonance, which I employed in the following investigation, was suggested by me a year ago[1]. It is the object of this paper to describe this method at some length and to illustrate, by some of the more definite results so far obtained, the simplicity, sensitiveness and reliability of the method. I shall also point out that this method of resonance analysis works quite satisfactorily even in those cases alluded to above where the sliding contact method would, in all probability, fail.

II. DESCRIPTION OF THE METHOD.

Consider the following arrangement of circuits: A non-self-inductive resistance, *ab* Fig. 1*a*, is inserted in the circuit of an alternator A and the primary B of a transformer. In shunt with *ab* is a circuit, *a*, *c*, *d*, *b*, consisting of an inertia coil, c, of a large number of turns of copper wire of low resistance, about 10 ohms, but containing no iron, and a condenser, *d*, divided into subdivisions ranging from .001 M. F. up. In shunt with the condenser, *d*, is an electrostatic voltmeter, *e*. The self-induction of the coil, *c*, can be varied by throwing a larger or smaller number of its sections into the circuit. The resistance can be varied by a rheostat, *f*. Suppose now that the self-induction of *c* is kept constant, and that the capacity of the condenser is gradually increased from zero up. Whenever a capacity has been reached which, with the self-induction of the circuit *a*, *c*, *d*, *f*, *b*, *a*, produces resonance with one of the harmonics in the main circuit, then the resonant rise of potential will produce a large deflection in the voltmeter. In this manner all the harmonics which are present in the current of the main circuit can be detected in the course of a few minutes. If the resonator circuit, *a*, *c*, *d*, *f*, *b*, is placed in shunt with the non-self-inductive circuit (this circuit is denoted in Fig. 1*a* by a line beaded with asterisks and running from one pole of the alternator to the other) consisting of a bank of incandescent lamps, then the harmonics of the impressed electromotive force can be detected in the same manner. The ratio of the amplitudes of these harmonics to that of the fundamental can also be determined by this method, if desirable, provided the conditions of the experiment are properly arranged. For let the current in the main circuit be $x = a_1 \sin pt + a_3 \sin 3\,pt + \ldots + a_a \sin a\,pt + \ldots$ then the drop between *a* and *b* can be represented by

$$e = b_1 \sin pt + \ldots + b_a \sin a\,pt,$$

where $b_a = a_a\, r$,

and r = ohmic resistance between *a* and *b*.

Denoting now by

L the self-induction of the resonator *a c d f b a*;
R the resistance of the resonator *a c d f b a*,
C the capacity of the resonator *a c d f b a*,

then it can be easily shown[1] that the current in the resonator will be

$$y = \sum \frac{b_a}{\sqrt{a^2 p^2 \left(\frac{1}{a^2 p^2 C} - L\right)^2 + R^2}} \sin (a\,pt - \varphi_a).$$

If, therefore, the capacity *C* is adjusted in such a way that

$$\frac{1}{a^2 p^2 C} - L = 0,$$

then the circuit will be in resonance with the harmonic of frequency *a b*; and if *L* is sufficiently large and *R* sufficiently small (two conditions which are very easily fulfilled), then the current *y* is to within a small fraction of a per cent. given by

$$y = \frac{b_a}{R} \sin a\,pt.$$

The amplitude of the potential difference in the condenser which is measured by the voltmeter *e* is given by

$$P_a = \frac{a\,p\,L}{R}\, b_a.$$

In the same way we obtain for the fundamental frequency

$$P_1 + \frac{p\,L}{R}\, b_1.$$

Hence

$$\frac{P_a}{P_1} = a\frac{b_a}{b_1} = a\frac{a_a}{a_1}.$$

This gives the ratio of the amplitude a_a of the harmonic of frequency *a p* to that of the fundamental. Let $a = 5$, then

$$\frac{1}{5}\,\frac{P_5}{P_1} = \frac{b_5}{b_1} = \frac{a_5}{a_1}.$$

The voltmeter readings which give P_5 and P_1 magnify that ratio five times in the case of the fifth harmonic, and it can be easily seen that a similar relation holds true for other harmonics. This is a very desirable feature of the method, considering that the amplitudes of the upper harmonics are generally small in comparison to the amplitude of the fundamental.

When quantitatively very accurate results are desired, then a low resistance, say one ohm, should be used for the section *a b*, and an electrometer capable of giving a large deflection for about ten volts.

The principal interest, however, in the study of the distortion of alternating current waves, is centered not so much in the exact ratio of the amplitudes of the harmonics to the amplitude of the fundamental waves as it is in the causes producing these harmonics and the conditions which modify the effects of these causes. Hence a quantitatively less accurate arrangement will do, provided that it is very sensitive, simple and easily manageable. Such an arrangement is given in Fig. 1*b*.

It differs from that given in Fig. 1*a* in the substitution of an air core transformer coil *a′ b′* for the non-self-inductive resistance *a b*. The secondary of this coil forms a part of the resonator circuit. For every harmonic of the inducing current we shall have a harmonic electromotive force of the same frequency in the resonant circuit. By varying the capacity in the resonator and watching the voltmeter needle, we can tell, by the deflection of the needle, whenever we have reached the capacity which, with the self-induction of the resonator, brings this circuit into resonance with one of the harmonics. A reference to Fig. 2 will explain this more clearly.

In this figure the low horizontal row of figures refers to the two-peaked curve, the upper row refers to the dotted flat-peaked curve. The vertical column denotes the voltmeter readings in volts. Consider now the two-peaked curve. It expresses the law of variation of the voltmeter readings when the capacity of the resonator circuit is varied from 0 to 2 microfarads, the self-induction being kept constant. The readings are recorded in Table I.

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[1] M. I. Pupin, "Electrical Oscillations of Low Frequency and Their Resonants." *American Journal of Science*, Vol. XIV., p. 429, May, 1893.

[1] For further information see the author's paper cited above.

TABLE I.

Capacity in M. F.	Voltmeter Readings in Volts.
.18	62
.181	68
.182	73.5
.183	79
.184	89
.185	96
.186	104
.187	110
.188	120
.189	126
.190	127
.191	125
.194	99
.198	71
.202	Very low.
1.65	69
1.70	89
1.75	120
1.80	146
1.808	146
1.817	145
1.897	96
1.976	60

The voltmeter employed in all these experiments was a Sir William Thomson's multicellular voltmeter with a range from 60 to 240 volts. The curve was obtained from a 10 H. P. Fort Wayne eight pole alternator with smooth core armature feeding a 5 K. W. Stanley transformer (closed magnetic circuit), the secondary being open. It is seen that resonance took place at .190 M. F. and 1.8 M. F. The capacity of the inertia coil c', Fig. 1*b*, and of the voltmeter as gathered from all experimental data was about .011 M. F. so that the real capacities at which resonance took place were .201 M.F. and 1.81 M.F., that is, in a ratio to each other as 1 : 3^2. It will be seen, however, that a very accurate knowledge of capacity is not required in the following experiments.

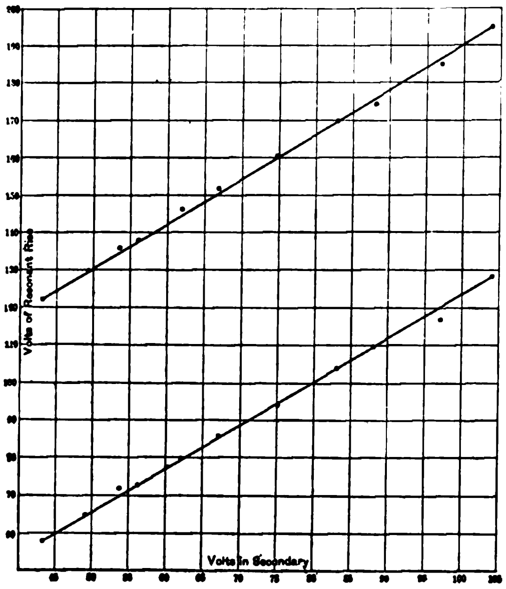

FIG. 5.

The frequencies detected by the two-peaked curve, which I shall call the resonance diagram, were the fundamental and the first odd harmonic, that is the harmonic of three times the frequency of the fundamental. The resonance diagram has of course as many peaks as there are frequencies in the inducing current.[1] The dotted curve (flat-peaked) in Fig. 2 was plotted on an enlarged scale from the readings taken in detecting the first harmonic, represented by the sharp peak of the resonance diagram, and represents this peak spread out, so as to show how the various readings fit into a well defined and symmetrical curve such as required by theory. It also shows that a condenser of small subdivisions must be employed in order to detect higher harmonics. But it should be observed that these higher harmonics can also be detected with coarser sub-divisions, provided the self-induction of the inertia coil is made small enough.

DESCRIPTION OF EXPERIMENTS.

The resonance diagram obtained by the method of Fig. 1*b* gives the number of harmonics which are present in the inducing current. It does not give the exact value of the amplitudes of these harmonics. It would be somewhat premature to discuss the theory of the resonance diagram obtained by this arrangement, and to show how the ratio of the amplitudes of the harmonics to that of the fundamental frequency of the inducing current, that is, the exact color of this current, could be calculated from the ratio of the height of the peaks in the resonance diagram. Suffice it for the present to mention only that the peaks of this diagram represent the amplitudes of the harmonics, magnified about proportionally to the square of the frequency. For instance, the resonance diagram in Fig. 2 tells us that the amplitude of the first odd harmonic in the inducing current is about one-ninth of the amplitude of the fundamental. The determination of the exact value of this ratio was not the object of the following experiments. Their aim was to detect the presence of harmonics, to trace their origin and to study their variation with the variation of the load and of other elements of the circuit on which these harmonics seem to depend.

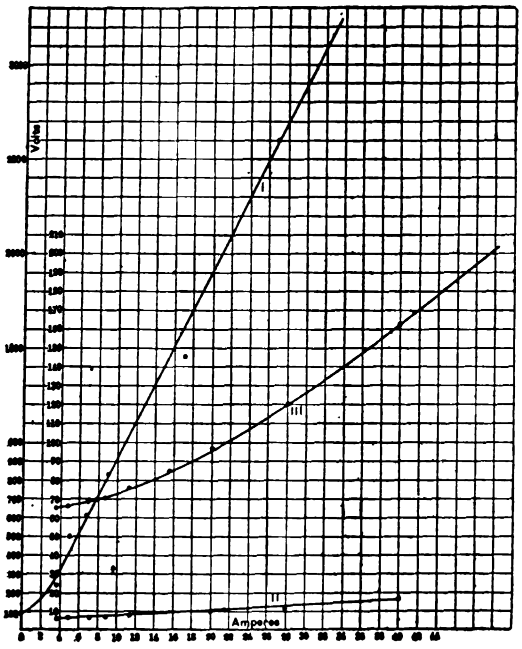

FIG. 6

Preliminary Tests.—In order to form an estimate in how far the experimental data obtained by the arrangement of Fig. 1*b* agreed with the theory, the following tests were applied:

a. Study of the damping effect of the dielectric in the condenser.

Let L = self-induction of the resonator circuit.

Let R = resistance of the resonator circuit.

Let P = amplitude of the difference of potential in the condenser when the point of resonance has been reached.

Let E = amplitude of impressed electromotive force in the resonance circuit.

Then according to theory

$$P = \frac{p\,L}{R}\,E.$$

Hence if the R is varied P will vary also, but in such a way that

$$P\,R = \text{constant}.$$

That is to say, if we vary the resistance of a resonant circuit, and tabulate the voltmeter deflection for every particular resistance, and then plot a curve taking the resistances for abscissæ and the voltmeter readings for ordinates, we should, according to theory, obtain an equilateral hyperbola. Curves II and III, Fig. 3, were obtained that way; the frequency employed was that of the 10 H. P. alternator, that is, 130 periods per second.

TABLE II.

Resistance in Ohms.	Voltmeter Reading with a Mica Condenser.	Voltmeter Reading with a Paraffin Condenser.	Theoretical Value of Voltmeter Reading.
38	183	170	225.6
48	155	148	178.9
53	144	137	161.8
58	134	128	147.8
63	125	120	136
68	118	113	126
78	105	101	110
88	94	91	97.4
98	85	83	87.5
108	78	76	79.4
118	72.5	70	72.6
128	67	65	65.5
138	62	60	60

The experimental data from which they were plotted are given in Table II. Curve II was plotted from voltmeter readings obtained with a mica condenser. Curve III represents the corresponding readings obtained with a paraffin condenser and given in the third column of Table II. Curve I represents the theoretical curve which would have been obtained if the law of variation of the voltmeter readings with the resistance had been the same throughout as it was at low readings. On account of the damping effect due to dielectric viscosity in the condenser a deviation from the above mentioned hyperbolic relation was of course expected, but it was quite a pleasant surprise to find a perfect regularity of these deviations. These curves indicate a rapid increase in the dielectric damping with the voltage, and also the superiority of mica to paraffin, especially at higher voltages. They also suggest that at low voltages and at frequencies over a hundred periods per second, this difference between the two substances is inappreciable. Similarly the damping effect of the magnetic viscosity of iron is small at low magnetizations, such, for instance, as would be produced by a telephonic current, and at frequencies which are well within the range of higher telephonic frequencies, say 750 periods per second. It is well to point out here that electrical resonance offers a very convenient method for studying the viscosity of iron and of dielectrics.

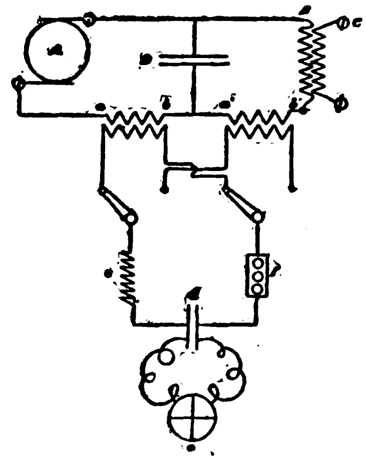

FIG. 7.

Similar curves and similar results were obtained with higher harmonics. This experimental test shows, therefore, that the relative values of the amplitudes of the harmonics to that of the fundamental frequencies are not seriously distorted by the dielectric damping of the condensers, especially when one operates with moderate voltages as was the case in the following experiments.

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[1] I have never detected an even harmonic in alternating current waves produced by ordinary commercial alternating current apparatus, and conclude, therefore, that such harmonics do not exist there. In machines of perfectly symmetrical construction even harmonics should of course not appear, as observed some time ago by Prof. Ayrton. Alternators with slotted armatures give waves in which all the odd harmonics up to the harmonic of nine times the frequency of the fundamental can be easily detected. As a rule the first odd harmonic is the strongest.

(*b*). *Second Test of the Resonator Indications.*—This test is represented graphically by diagram Fig. 4. Two transformers C and D had their secondaries connected in series. The primary of the air-core transformer E formed a part of their circuit. The secondary of this transformer was a part of the resonator F. The transformer C, a Stanley 5 K. W. (closed magnetic circuit) was fed by the 10 H. P. alternator mentioned above (130 P. P. S.), the transformer D, of induction coil type with a cylindrical core, of fine iron wire, was fed by 1 H. P. alternator with slotted armature (278 P. P. S.). Both alternators were run simultaneously at full excitation. First, the primary circuit of the large alternator was broken so that the current in the circuit C D E was due to the action of the small machine alone. The resonator detected a resonant rise of 240 volts at capacity .407 M. F., and another of 150 volts at capacity .044 M. F. These were evidently the fundamental and the first odd harmonic. Then the circuit of the small machine was broken and that of the large machine closed so that the current in the resonator was due to the action of the large machine alone. The resonator detected a resonant rise of 220 volts at capacity of 1.78 M. F. This corresponded to the fundamental frequency (130 P. P. S.) of the large machines. Finally both circuits were closed, so that the current in the resonator was due to the simultaneous action of the two machines. The same resonant rises of potential were detected by the resonator and at the same capacities as before, in perfect agreement with theory.

This experiment afforded another opportunity of testing the theory which underlies this resonance method of studying the wave curves of current and electromotive force. It is this: If two or more electromotive forces of different frequencies are impressed upon the resonator circuit and their resonant rises of potential are determined for a given resistance in this circuit, then, according to theory, the ratio of these rises should remain the same for all other resistances within the limits within which the periodicity of the circuit is practically independent of the ohmic resistance. Accordingly, the resistance of the resonator, F., Fig. 4, was varied gradually from 100 to 250 ohms, and the resonant rises of potential produced by the fundamental frequencies of the two machines (130 and 278 P. P. S.) were carefully determined for each particular resistance. The ratio of these rises remained constant to within five per cent., but the deviations were now in one direction and now in the other, and they were undoubtedly due to the variation in the excitation, and the speed of the small machine, both of which depended on the potential of the electric mains of the college plant, which, of course, could not be kept very constant for so long an interval of time as is necessary for this experiment, which was about fifteen minutes.

It is interesting to observe here that three air-core transformers like E, with three resonators like F, when placed in the circuit, C D E, and each resonator tuned to one of the frequencies of the circuit, represent an exact analogy of Helmholtz's well-known arrangement of acoustical resonators which he employed in the analysis of vowel sounds. The variety of exceedingly instructive experiments which one can perform with such a multiplex resonance circuit is very large and most interesting. It has long formed my favorite subject for an extended series of experiments whose results, however, are beyond the limits of this paper. In all experiments of this kind the voltmeter, which is attached to each resonator, performs the same office as König's sensitive monometric flames in the well-known experiments on acoustical resonance, and it should be noted here that they are just as sensitive. In fact, in electrical resonance experiments one is continually impressed with the striking resemblance between resonance phenomena in electricity on the one hand and those in sound on the other. This resemblance is a trusty and suggestive guide.

(*c*). *Sympathetic Resonance.*—Now, an acoustical resonator tuned to a certain pitch will respond, feebly, to be sure, but distinctly, to a simple sound of a frequency which is an exact sub-multiple of its own frequency. A similar phenomenon might exist in electrical resonance, though ordinary alternating current theory does not lead us to expect anything of the kind. But some experimental results, which will be given below, led me to suspect that a sort of *sympathetic resonance* might exist, that is to say, a simple harmonic current might perhaps be capable of producing by induction a resonant rise of potential in a resonator, which is tuned to a frequency which is an exact multiple of the frequency of the inducing current. If that were the case, then a resonant rise of potential in a resonator would not necessarily mean that an upper harmonic in the inducing current has been detected, and, therefore, the indications of an electric resonator might be misleading. To investigate this point the air core transformer E with the resonator F, Fig. 4, was connected to the secondary of the 5 K.W. transformer and the current gradually increased by varying gradually an electrolyte resistance. The feeding machine was the above-mentioned 10 H. P. alternator, with smooth core armature. Here I must disturb somewhat the logical sequence of this paper by stating that the secondary current, produced by this machine and transformer, when flowing through a non-self-inductive resistance in the external circuit or through a coil of small self-inductance possessing no iron core, showed under ordinary tests no distortion worth mentioning. But when the secondary current was increased, and with it the electromotive force induced in the resonator, the harmonics began to appear more and more distinctly. When the secondary current was 11.5 amperes and the electromotive force induced in the resonator was 133 volts the resonant rise of potential was as follows:

For the harmonic of—

Three times the frequency of the fundamental the potential rose from 133 to 155 volts.

Five times the frequency of the fundamental the potential rose from 133 to 139 volts.

Seven times the frequency of the fundamental the potential rose faintly.

Nine times the frequency of the fundamental the potential rose not perceptibly.

The resonant rise with the fundamental frequency would have been with the initial potential of 133 volts several thousand volts, so that the resonant rises obtained for the upper harmonics were extremely small in comparison. The conclusion is, therefore, that if such a thing as sympathetic resonance really exists, it is so feeble at small voltages in the resonator as to escape detection. It could, therefore, in no way modify the results recorded in this paper, since these were obtained almost invariably with resonant rises of potential which started from very small initial voltage.

These preliminary experimental tests demonstrate clearly that a resonator of the type given in Fig. 1*b* is quite capable of detecting all the frequencies that may exist in an alternating current wave, that its indications are in good agreement with the theory as far as the fundamental frequency is concerned, and that it gives us a fairly approximate idea of the relative strength of the harmonics. Additional evidences proving the correctness of its indications will be found among the results of the following experiments.

(*To be continued.*)

THE DEVELOPMENT OF THE ELECTRIC TELEGRAPH.—III.

BY STEPHEN VAIL.

Mr. Geo. H. Stockbridge, the well-known electrician, has thus written: "Alfred Vail was, by training and endowment, an inventor. His father, Judge Stephen Vail, was the proprietor of the Speedwell Iron Works at Morristown, New Jersey, and young Alfred, thirty years of age at the date alluded to (September, 1837,) had spent a great deal of time as a boy in his father's works, indulging his inherited taste for mechanical pursuits. Simultaneously with his work there, he had been an ardent student of scientific matters, and had become thoroughly grounded in the basic principles of natural philosophy. So that later when, as a student at the University of the City of New York, he went to call on Prof. Morse, on that memorable second of September, he was prepared, not only to grasp the magnitude of the conception, but to understand perfectly the operation of the apparatus and the problems still awaiting solution. There were still doubts to be resolved, but in the end he decided to 'embark in the enterprise,' and 'sink or swim with it.' The enthusiasm of his son soon won over Judge Vail, and on September 23, 1837, an agreement was entered into between Prof. Morse and Alfred Vail, by the terms of which Mr. Vail agreed 'to devote his personal services and skill in constructing and bringing to perfection, as also in *improving*, the mechanical parts of said invention, ... without charge for such personal services to the other proprietors, *and for their common benefit*,' and it was also stipulated that 'he should construct at his own expense and exhibit before a Committee of Congress one of the telegraphs of the plan and invention of Morse, and that he should assume the expense of exhibiting the apparatus and of procuring patents in the United States.' Provision was made for securing to him an interest in any foreign patents which he might furnish the means to obtain. For these considerations Mr. Vail was to receive a one-fourth interest in the invention in the United States.

ALFRED VAIL.

"When Vail had once committed himself to the new work, his devotion to it assumed the character of a passion. The shoot planted by Morse had sprung up in the young man's mind as an independent growth, equal in strength and vigor to the original tree. If the conception could have had its birth with him, he could not have taken more interest in its development. The elation and depression which alternated in his mind from time to time were intensely personal. It is doubtful if the history of these months, whilst Vail and young Baxter, a confidential assistant, were at work in their locked room at the Speedwell Works, can be adequately explained except upon the hypothesis that the successes and failures were Vail's and *not* Morse's. The gradually changing relations of the two men, Vail's undefined feeling, which finally grew into expression, that Morse had not given him due public credit for his services, tell a story of natural jealousy on Morse's part and of an outraged sense of justice on Vail's part which, not having received its proper comedy denouement, in a generous acknowledgment from Morse, has lately risen to do poetic justice of the retributive sort by exposing Morse's misdemeanor."

As will be inferred from the foregoing, Morse and Vail had transferred the scene of their experiments and development of the invention from New York to the Speedwell Iron Works, and on the 6th of October, Morse filed in the United States Patent Office a "caveat," signed October 3, stating in the petition (dated five days earlier) "that the *machinery* for full practical display *is not yet completed*, and he therefore prays protection of his right until he shall have matured the machinery." The specification declares: "I have invented a new method of transmitting and recording intelligence, by means of electro-magnetism. . . . . For the purpose aforesaid, I have invented the following apparatus, namely: First, a system of signs by which numbers, and consequently words and sentences, are signified; second, a set of type adapted to regulate and communicate the signs, with cases for convenient keeping of the type, and rules in which to set up the type; third, an apparatus called a port rule for regulating the movement of the type rules, which rules by means of the type in their turn regulate the times and intervals of the passage of electricity; fourth, a register which records the signs permanently; fifth, a dictionary or vocabulary of words numbered and adapted to this system of telegraph; sixth, modes of laying the conductors to preserve them from injury." The several parts are then more particularly described. "The signs are the representatives of numerals." The register comprises an electro magnet actuating, by its armature, a lever or pendulum, carrying a pencil or *fountain pen*, or small printing wheel, for marking on a strip or sheet of paper, as already described. The modes of laying the conductors are by insulating the wires with silk or cotton wrapping, and coating with caoutchouc or other non-conductor, and also by enclosing them in iron, lead or wooden tubes. The document concludes: "What I claim as my invention, and desire to secure by letters patent, and to protect for one year by a caveat, is a method of recording permanently electrical signs which, by means of metallic wires or other good conductors of electricity, convey intelligence between two or more places."

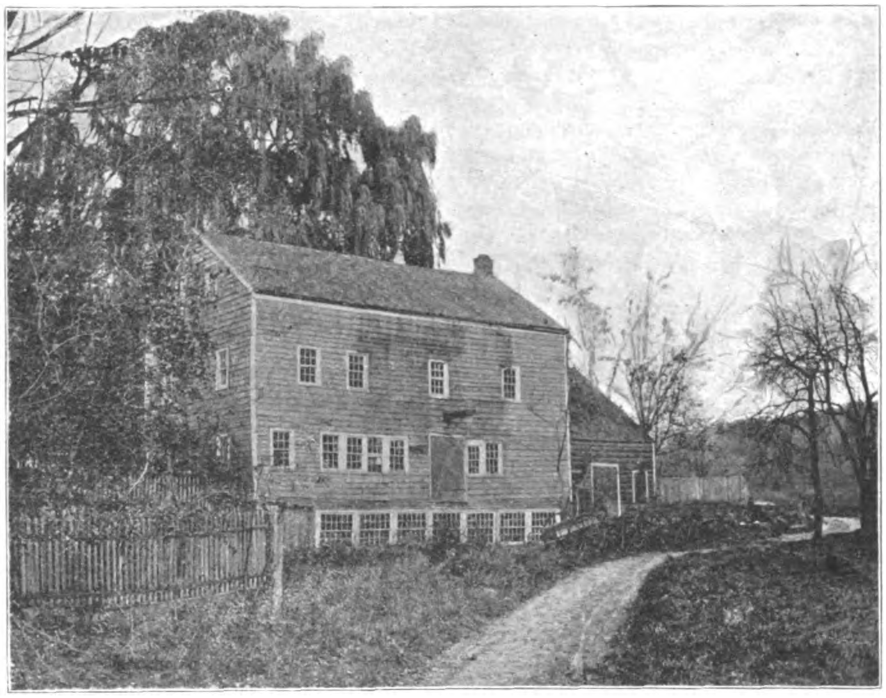
Of the above described apparatus, the two most important features were those numbered the first and the fourth—the system of signs and the recording device; and though neither of these presented much originality, the method of the former being that long-established for naval signals, and the clock-moved fillet of the latter being essentially the arrangement long employed for self-registering instruments generally, yet the *combination* of these parts with the others undoubtedly possessed great practical merit and none the less that the several elements were evidently worked out independently by the inventor. It is not a little remarkable, however, that of the specified six parts of the earliest invention of Morse, *not one enters into the so-called "Morse telegraph" of to-day!*

Having finished his laborious task of numbering a dictionary, Morse wrote on October 24, 1837, to Mr. Vail: "The dictionary is at last done. You cannot conceive how much labor there has been in it, but it is accomplished; and we can now talk or write anything by numbers."

On the 29th of September, Morse went to Speedwell for a few days, partly to observe the progress of the new machinery, and partly with the intention of painting the portraits of Judge Vail and his wife, in fulfilment of a commission which had been given him as a delicate and considerate manner of relieving his pressing pecuniary necessities. Meanwhile, Alfred Vail and his young assistant, William Baxter, were engaged night and day in pushing forward the construction of the new machinery.

After his return to New York, Morse, on the 13th of November, 1837, wrote again to Mr. Vail, saying: "I arrived in time to see the experiment Prof. Gale was making with the entire ten miles, and you will be gratified and agreeably surprised when I inform you that the result now is that, with a little addition of wire to the coils of the small magnet which I had all along used, the power was as great, apparently, through ten as through three miles. This result has surprised us all (yet there is no mistake), and, I conceive, settles the whole matter."

The construction of a more complete apparatus was carried on at the Speedwell Works by Mr. Vail, and upon the completion of the new receiving and recording instruments an experimental exhibition over three miles of wrapped copper wire, extending around the walls of a large room in one of the factory buildings, was made before Judge Vail on the 6th of January, 1838, he dictating the sentence, "A patient waiter is no loser," as the first message to be sent over the wire. On the 11th of the same month, an exhibition for the public was given and the account in a Morristown journal thus alludes to it: " . . . . The words were put up into numbers through the dictionary; the numbers were set up in the telegraph type in about the same time ordinarily occupied in setting up the same in a printing office; they were then all passed complete by the port rule"; and being automatically recorded at the extreme end of the wire, "the marks or numbers were easily legible, and by means of the dictionary were resolved again into words."



THE SPEEDWELL WORKS, 1838.

Shortly after this Mr. Vail devised, for the first time, a system of *alphabetic* symbols for the telegraph. It should not be forgotten that the vertical recording lever of the original Morse apparatus was so arranged that it must *necessarily* make a *continuous* line, either straight or zigzag. It was never devised for an "alphabet," and was *incapable* of an intermittent *dot and dash* marking. The new instrument completed by Mr. Vail, and first operated on the 6th of January, 1838, was differently organized, the recording-lever being for the first time arranged *horizontally*, and having an up and down movement, with an upright magnet under one end and the moving fillet of paper above the other.

It appears from various concurring testimonies that the new recording instrument constructed for Prof. Morse by Mr. Vail (in accordance with the terms of the agreement of partnership existing between them), during October, November and December, 1837, was entirely of his own design *without any suggestions from Morse*, and that its arrangement for discontinuous marking was specially contrived by its maker for *an alphabet exclusively devised by himself*, which he abstained from publicly claiming owing to a delicate sense of obligation incurred by his contract with Morse to render him every assistance in perfecting the mechanical arrangement of the telegraph.

That Morse had no conception on the 3d of October, 1837, of the form of instrument contemplated by Mr. Vail is clearly shown by his autographic "caveat" of that date, and his letter of October 24 to Mr. Vail, announcing the completion of the numbered dictionary (in which he wrote, "We can now talk or write anything by numbers",) is equally conclusive evidence that at this later date he was still unconscious of any alphabetic improvement.

(*To be continued.*)

Prof. Crehore's Marriage.

The wedding of Miss Sara H. Buck and Prof. Albert Cushing Crehore took place on the evening of the 10th inst., in the 18th Street Methodist Church, Brooklyn. The ceremony was followed by a reception at the house of the bride's parents, 215 Seventeenth street. Miss Mary Louise Crehore, sister of the groom, was maid of honor and Prof. Frederick Bedell was best man.

Prof. Crehore has lately retired from the Cornell faculty, having been appointed assistant professor of physics at Dartmouth College. The couple will make their future home at Hanover, N. H.

Personal.

Mr. L. W. Collins, who is well known as a successful advertising man through his connection with ELECTRICITY and the *Electrical Engineer*, has joined hands with Mr. C. E. Lee, under the firm name of Lee & Collins. They will handle a choice line of specialties in Chicago, with offices at No. 65 Lees Building.

Some Extraordinary Discoveries in Electro-Therapeutics.

We have received the following report of Dr. E. H. Woolsey's paper read before the section of Physiology of the American Medical Association at their meeting at Oakland, California, June 6, which if true, and it bears every evidence of truth, is the most interesting paper yet produced in Electro-Therapeutics. Too often papers of this kind are composed of mere platitudes, devoid of—we were going to say—sense, but at any rate so involved in the terms of charlatanry with which the science is still so loaded down as to be of little value to any one. In general electro-therapeutical papers are not electrical at all, or at least are not couched in terms understandable by electricians, and the very use of the terms, if they mean anything at all, means a conflict or confusion of ideas, or an adherence to opinions long since exploded by scientific men. This is the reason why electro-therapeutics, even when discoursed on by reputable practitioners, is regarded with suspicion, that if the terms involved are used according to the code, they show the user either to be ignorant of his science or else a charlatan. We have always believed that good would come from this application of electricity, but the science can never prosper until it throws off the toggery of charlatanry and takes on the nomenclature of science. Here is the report divested of verbiage, which shows some of the remarkable results attainable by the true scientist in the use of electricity as a remedial or palliating agent. If these results are true, as we said before, they are not only remarkable in themselves but promise remarkable things for the future.

Dr. Woolsey's paper was too technical to be of interest to the public, for only the most advanced scientists could follow its details intelligently. He presented elaborate tables, upon which a summary of experimental work upon domestic rabbits, covering a period of six months, was recorded.

He explained that some of the rabbits had received mild electrical treatment, and others treatment of varying strength; that some had only received a single treatment in order to observe after death the effects of such treatment upon the organism, while many were treated a week or more, and in these, at the post-mortem examination, was observed the influence of electricity upon the various organs.

Among the many interesting discoveries made were the following: That when the electric current was used in a certain direction for a number of days congestion of the lungs was invariably present, and that fully developed pneumonia was in many cases pronounced. Such results were shown to have occurred even with the use of mild currents. On the other hand it was shown that in a different direction of current, especially where mild currents were used, a bloodless condition of the lungs was produced. These experiments convey the idea that electricity may come to be useful in the treatment of lung diseases, but it is also suggestive that electricity is a dangerous remedy in unskilled hands.

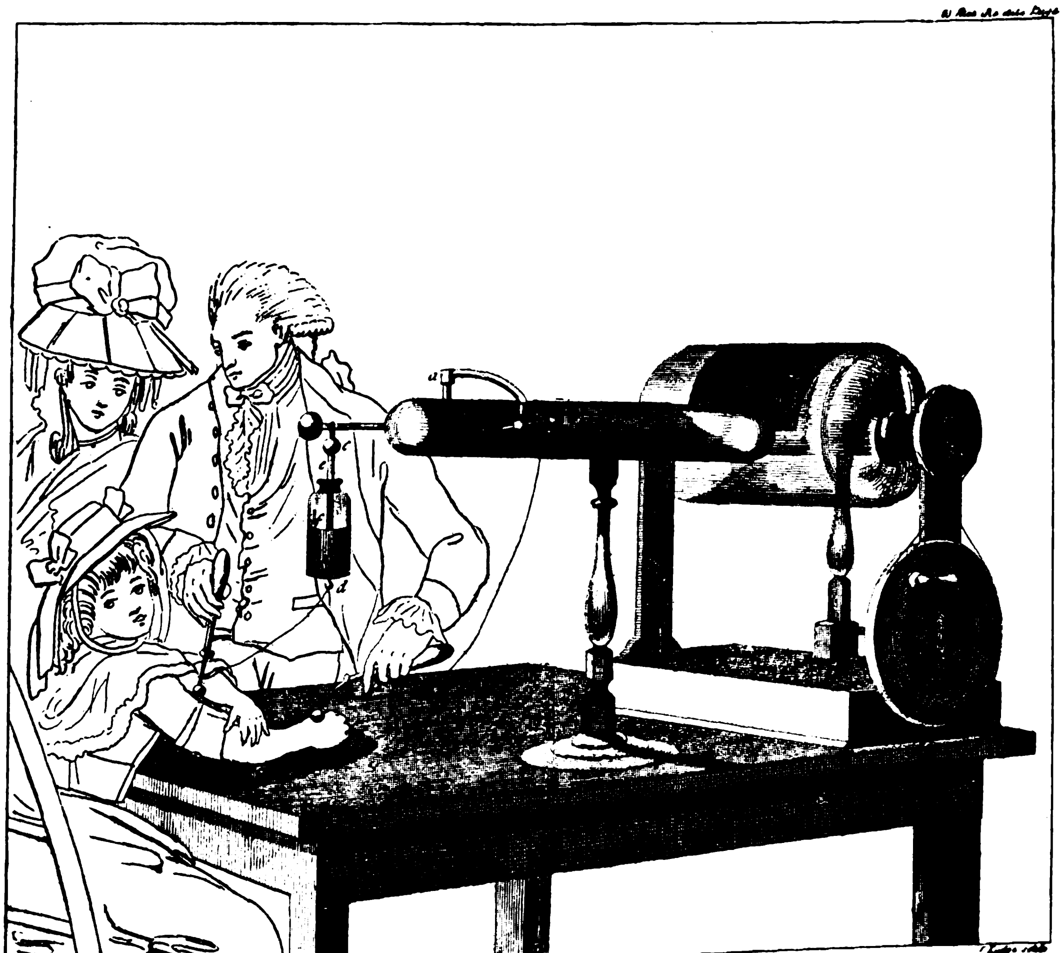
It was also shown that electricity had in some cases caused congestion of the brain and spinal cord when the current was used in a certain direction, and that opposite conditions were produced when the electric current was used in an opposite direction. The suggestion was most apparent here that these discoveries will lead to the successful treatment of brain and nervous diseases, and this suggestion was strengthened by the report of microscopical examinations made by Dr. Charles M. Fisher, and also the report on the examination of the eyes of rabbits experimented on by Dr. E. F. Card, which reports were embodied in Dr. Woolsey's paper.

It was also shown that the kidneys, liver, bladder and sexual organs had been congested by certain electrical currents, and by opposite currents opposite conditions had been produced.

Dr. Woolsey avoided expressing opinions, but confined himself to the presentation of the facts observed during the course of his experimental work, though the conclusion from the facts presented is clear that he is laying the foundation of a system of electrical treatment, so that in future physicians will be able to control diseases of the several organs of the body. But at every step of the proceedings the inference was also clear that electricity is the most dangerous remedy and that even mild currents are capable of producing disease in various parts of the body unless used with the most consummate skill. Any man who was present at Dr. Woolsey's lecture who would permit himself to be treated by electricity by a quack is a fool.

It was shown by elaborate charts that the invariable immediate effect of electricity in all cases and with every current used was to lower the temperature, but that under some circumstances a reaction followed, with the temperature higher than normal. The suggestion under this head was that it is possible to control fever by electricity.

One of the most important points brought out was that under certain uses of electricity the pains at childbirth may be mitigated and that delivery may be hastened without injury to mother or child. He showed in his table of observations that where a certain current was used with female rabbits abortion and premature labor was brought on, sometimes after a single seance and at other times after several treatments, and in many cases even with very mild currents, without any apparent disturbance of the health of the mothers. A singular thing in this connection was that in every case the fœtuses were alive at birth, the electric current not having disturbed the health of the offspring in the least.



Application of Static Charge to Therapeutic Purposes, 1787.

After reading the paper Dr. Woolsey illustrated it with a couple of rabbits, the effect of electrical currents of different strength, etc., and the effect of current direction upon the animals. He explained that electricity should never be used without a rheostat, to control the current exactly as required, and that the only reliable measure of the strength of current thus far invented was the Weston milliamperemeter. He exhibited the working of these instruments, which were connected with a portable galvanic battery.

He insisted that the portable batteries did not give a sufficiently steady current for reliable use in practice and that the current from stationary batteries was the only one that could be safely used.

This point was well illustrated by tapping the armature of the battery used at the section where such tapping or even jarring of the battery itself, while the rabbits were receiving the electrical current, caused them to receive a shock, a point that such shocks are unavoidable with portable batteries.

The illustration with the rabbits attracted a great deal of interest and led to most complimentary remarks on Dr. Woolsey's zeal by the president of the section and others present.

An Interesting Old Book.

There has recently come into the writer's possession an old work on Electricity bearing the following on its title page:

"An Essay on Electricity explaining the Theory and Practice of that useful Science; and the Mode of Applying it to Medical Purposes. With an Essay on Magnetism. Third Edition. Corrected and considerably enlarged. By George Adams, Mathematical Instrument Maker to His Majesty. London: Printed by R. Hindmarsh, for the Author, and sold by him at Tycho Brahe's Head, No. 60 Fleet street. 1787."

The yellow pages of this ancient tome seem scarcely in keeping with the copperplate cuts of apparatus which but for their equally yellow stains might readily be mistaken for apparatus of the present day. There is one cut in particular, the frontispiece, reproduced herewith, illustrating the application of the static charge to therapeutical purposes, which might find appropriate place in therapeutical treatises of the present day. The apparatus is not of the exact form of that used to-day, but of a type well known fifteen or twenty years ago, while the costumes of the little girl and the mother, and the method of treatment employed are certainly modern in every respect.

Glancing through the book our attention is first attracted to the following paragraph in the preface:

"The science of electricity is now generally acknowledged to be useful and important; and there is great reason to think that at a future period it will be looked up to as the *source from whence the principles and properties of natural philosophy must be derived.* Its utility to man will not be inferior to its dignity as a science."

How well this prophecy has been fulfilled, the accomplishments of the present day attest. The tendency of modern thought and research is certainly toward the belief that electricity is the underlying principle or agency of most if not all observed physical phenomena. Such views were not held 100 years ago, for there were no observed facts upon which to base such a theory, and for this reason this paragraph seems especially prophetic when viewed in the light of the present day.

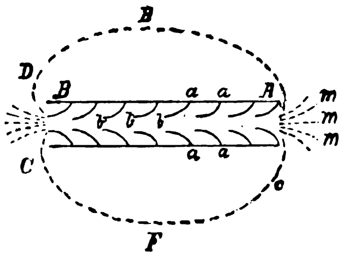


FIG. 99.

Another paragraph from the preface is worthy of quotation in that it shows the philosophical mind of the author. It is: "Our view of things is so circumscribed, and the mysteries of nature so profound, that it is not easy for us to determine whether the received theory is founded on the basis of truth and conformable to nature, or whether we shall be considered by future philosophers as mere children, amused and satisfied with imperfect opinions and ill-digested theories."

Chapter I is introduced in this way: "It must appear surprising to every searcher after truth that electricity, which is now allowed to be one of the principal agents in producing the phenomena of nature, should have remained so long in obscurity, for, comparatively speaking, its existence was not known to the ancients. They were not, indeed, altogether ignorant of the peculiar properties of those bodies that we now term electrics *per se;* nevertheless their knowledge was circumscribed, being confined to the observation only of those phenomena which nature presented to their senses in the ordinary course of her operations; hence near two thousand years elapsed before any addition was made to the little which was known to Theophrastus, and this branch of natural history remained uncultivated till the happy period arrived when the philosopher was emancipated from the chains of hypothetic reasoning and the uncertainties of vague conjecture."

A little further along we come to an expression that has a familiar ring, viz., "*As electricity is in its infancy* when considered as a science, its definitions and axioms cannot be stated with geometric accuracy."

The author then proceeds to elucidate the science of electricity on the theories then held, which he briefly mentions in the text. The text is still further explained by a surprisingly complete series of experiments in static electricity, much of the apparatus for which is illustrated in very well executed engravings.

On page 66 is the following, which may have some contemporaneous interest: "The following very curious observations and experiments were made by Mr. Symmer. He had been accustomed to wear two pair of silk stockings, a black and a white; when these were pulled off together no signs of electricity appeared, but on pulling off the black ones from the white, he heard a snapping or cracking noise, and in the dark perceived sparks between them. . . . When the stockings were separated and held at a distance from each other, both of them appeared highly excited; the white positively, the black negatively. While they were kept at a distance from each other, both of them appeared inflated to such a degree that they exhibited the entire shape of the leg. . . . As they approach the inflation gradually subsides, and their attraction of foreign objects diminishes, but their attraction of one another increases. . . . When the stockings were suffered to meet, they stuck together with considerable force; at first Mr. Symmer found they required from one to twelve ounces to separate them; another time they raised seventeen ounces. . . . When the two rough surfaces were together, they raised fifteen pounds, one penny weight and a half."

The most interesting thing about this is the possible clue it affords to a more modern phenomenon. In studying the derivation of proper names we find that it was formerly customary for the second generation to add the word "son" to that of his patronymic. Thus Smith's son and his family became known as Smithson. By analogy Mr. Symmer's descendants may have become known by the name Symmerson, and thus have finally become corrupted into "Simpson." Assuming such to have been the case, we may also assume that the story of Mr. Symmer's trouble with his stockings was handed down as a tradition in his family until it had a reactionary effect upon his posterity which culminated in his descendant, Jerry Simpson, who, if current reports are to be believed, has no trouble whatever with his "*sox.*"

Mr. Adams cites a curious hypothesis to explain magnetism which he credits to Euler (Lettres à une Princesse d'Allemagne) which is sufficiently interesting to warrant reproduction. He says:

"Mr. Euler supposes that the two principal causes which concur in producing the wonderful properties of a magnet are, first, a particular structure of the internal forces of the magnets and of magnetic bodies; and secondly, an external agent or fluid, which acts upon and passes through these pores. This fluid he supposes to be the solar atmosphere, or that subtile matter called ether which fills our system.

"Indeed, most writers on this subject agree in supposing that there are corpuscles of a peculiar form and energy which continually circulate around and through a magnet; and that a vortex of the same kind circulates around and through the earth.

"A magnet, besides the pores which has in it common with other bodies, has also other pores considerably smaller, destined only for the passage of the magnetic fluid. These pores are so disposed as to communicate one with the other, forming tubes or channels by which the magnetic fluid passes from one end to the other. The pores are so formed that this fluid can only pass through them in one direction, but cannot return back the same way; similar to the veins and lymphatic vessels of the animal body, which are furnished with valves for this purpose. So that the pores of the magnet may be conceived to be formed into several narrow contiguous tubes, parallel to each other, as at A B, Fig. 99, through which the finer parts of the ether passes freely from A to B, but cannot return back on account of the resistance it meets with at a, a, b, b, nor overcome the resistance of the grosser ether, which occasions and continues the motion. For supposing the pole A of a magnet filled with several mouths or open ends of similar tubes, the magnetic fluid, pressed by the grosser parts of the ether, will pass towards B with an inconceivable rapidity, which is proportionable to the elasticity of the ether itself, this matter which, till it arrives at B, is separated by the tubes from the more gross parts, then meets with it again, and has its velocity retarded, and its direction changed; the stream, reflected by the ether, with which it cannot immediately mix, is bent on both sides towards C and D, and describes, but with less velocity, the curves D E and C F, and approaching by the curves *d* and *c*, falls in with the affluent *m m*, and again enters the magnet, and thus forms that remarkable atmosphere which is visible in the arrangement of filings on a piece of paper that is placed over a magnet."

Further along, many curious properties of the magnet are rehearsed and described, but reference to these must be deferred to another time.

BOOK REVIEWS.

AMERICAN STREET RAILWAY INVESTMENTS, A SUPPLEMENT TO THE STREET RAILWAY JOURNAL. Published annually for the use of Bankers, Brokers, Capitalists, Investors and Street Railway Companies. 216 pp., including 24 maps. Cloth. Price $5. "The Street Railway" Publishing Company, 26 Cortlandt street, New York.

This undertaking of our contemporary is a laudable one, and should be cordially received by the public. The wild-cat financiering, which has been too much a feature of the electric railway business, would not have been possible if the railway men themselves, and those who have been buying their securities, could have been brought into closer touch, and known better how to get at each other. The financing companies which have grown fat by assessing both the public and the street railway men, would not have been able to get a foothold. We shall present a further review of this work, showing by tabulation some remarkable facts not made plain enough as arranged in the work itself.

ELECTRIC LIGHT INSTALLATIONS. VOL. I. ACCUMULATORS. BY SIR DAVID SALOMONS, BART., M. A. 8vo. 159 pp. Illustrated. Seventh Edition. Price $1.50. London: Whittaker & Company; New York: D. Van-Nostrand Company.

As indicated above, this is the seventh edition of this well known work, which has been necessitated by the early exhaustion of the sixth edition. Opportunity has been taken on this occasion to thoroughly revise and greatly enlarge the work. To such an extent has this enlargement gone that the author has deemed it wise to divide it up into three volumes, the first of which, on Accumulators, is the one under review. In criticising this book we have nothing by which to compare it, as, strange to say, it is the only book that has been published on the subject. This speaks exceedingly well for the book, however, for the author covered the subject so fully and satisfactorily in his first edition, and has kept it so fully up to date by his successive editions, that others have found no opening for their talents in the same line. It is sufficient, therefore, to say that the seventh edition fully maintains the high standard of its predecessors.

Electric Light Installations. Vol. II. Apparatus. By Sir David Salomons, Bart., M. A. 8vo. 312 pp. Illustrated. Seventh Edition. Price $2.25. London: Whittaker & Co.; New York: D. Van Nostrand Company.

As the title implies, this, the second volume, is devoted entirely to the description of Apparatus, the special applications of the same being, except in a few instances, relegated to the third volume. To assist the descriptive matter, profuse use has been made of illustrations, which number no less than 294. We know of no work that goes so fully into this subject as this. The high commendation we are pleased to give Vol. I is extended also to this. As indicating the scope of the work, Chap. I is devoted to Engines; Chap. II to Dynamos and Motors; Chap. III to Instruments (measuring); Chap. IV to Governors; Chap. V to Switches and Switchboards; Chap. VI to Fuses, Cut-Outs, Connectors and Minor Apparatus; Chap. VII to Arc Lamps; Chap. VIII to Practical Applications.

Canadian Notes.

Hamilton has started to run Sunday street cars again, the service being from 10 a. m. to 1 p. m., and from 2 p. m. to 10 p. m.

S. A. Lazier & Sons have agreed to build an electric railway in Belleville, and to have the Front street line completed by August, 1895, in default of which they forfeit their franchise and $1,000. The company are given five years to complete lines in other portions of the city if they deem it advisable, as it was pointed out that they should not be bound to build residential lines if the Front street road did not pay.

Secretary McGowan of the Fire and Light committee, Toronto, has prepared estimates of the probable cost of the city putting up an electric light plant and running it themselves. His estimates are considerably higher than those of the city engineer, who recently took an extensive trip through the United States for the purpose of gathering information and data in regard to this very important subject which is now agitating the minds of Toronto's citizens.

The extension of the North American Telephone and Telegraph line between Kingston and Smith's Falls has just been completed.

The Toronto and Mimico Electric Railway Co. have applied for permission to operate their road over the new iron bridge which crosses the Etobicoke river, it being the intention of the company to extend the line to Oakville, and probably to Hamilton.

The Toronto Street Railway Company have finally adopted a guard for trolley cars which will be put into use on all the cars at once. It is a net with iron framework, padded with india-rubber and is very simple in its character. It has been in use on the Buffalo Street Railway for some time past with most satisfactory results.

General News.

What is Going on in the Electrical World.

Philadelphia.—The trolley has taken the place of horses on the Fourth and Eighth street line.

Onalaska, Wis.—The completion of the Onalaska and La Crosse electric line was enthusiastically celebrated here on the 4th inst.

Arcadia, Wis.—The city council has decided to have the streets lighted by electricity. Hitherto kerosene lamps have been used for this service.

Cohoes, N. Y.—It seems likely now that the projected electric railroad will be built immediately, as about half of the stock has been subscribed for.

Port Jervis, N. Y.—The proposed electric road from Port Jervis to Stroudsburg is to be built at once by the Delaware Valley Electric Railway Company.

Warren, O.—The Mineral Ridge and Niles Electric Railroad and appurtenances, which are to be sold at sheriff's sale August 11, have been appraised at $41,700.

Uhrichsville, Ohio.—It is reported that work will begin on the electric railroad between Uhrichsville and New Philadelphia by the 1st of August. The line will be about 9¼ miles long.

Middletown, Conn.—L. C. Whitney, superintendent of the New Britain Electric Light Company, has been appointed receiver of the Norwalk and South Norwalk Electric Light Company.

Dixon, Ill.--A franchise has been granted to the Rock River Railway Electric Company for the laying and operation of an electric street car line through this city to connect with the Rock River line.

Pittsburg, Pa.—The directors of the Homestead Street Railway have awarded the contract for building and equipping the line to the Electrical Construction and Engineering Company of New York.

Albert Lea, Minn.—The electric light and power house here of which C. G. Edwards was manager and principal owner was recently burned down, totally destroying the dynamos. The loss is put at $8,000.

Hollidaysburg, Pa.—The Robinson Machine Company, the leading industry at Bellwood, this county, manufacturers of electric machinery, have failed. Ira Wetzel and Charles Robinson have been appointed as the assignees.

Terre Haute, Ind.—The projected line of electric railway between Terre Haute and Brazil remains still a project, though efforts to organize a company and secure the necessary capital are meeting with some success.

Rome, Ga.—The Rome electric street railroad has been sold at sheriff's sale and bid in by John J. Seay for $31,740. Capt. Seay will probably take charge as president. The road will now be improved and the line extended.

Akron, Ohio.—A company of Akron and Massillon capitalists is said to be forming for the purpose of building an electric railway to connect the two cities by way of Turkeyfoot Lake, which is to be made an attractive resort.

Manchester, Conn.—As an outcome of the annual meeting of the Waring Electric Company last week, it was decided to place the company in the hands of a receiver. Judge Prentice appointed C. T. Welles of the City Bank of Hartford.

Austin, Tex.—The dam on the Colorado River, about three miles above this city, which is to furnish 100,000 H. P. for electrical transmission to this city, is completed. Bonds for $1,500,000 have been issued to construct the dam and plant.

Brooklyn, N. Y.—Mr. Edison is erecting three "portable power houses" near the Concourse at Coney Island for the purpose, it is said, of experimenting with the swells of the sea as a source of power for the operation of dynamos, etc.

Quebec, Can.—The Montmorenci Electric Power Company expect to be able in about a month to supply electric motive power in this city. The necessary machinery for producing it is about to be installed in the company's buildings at the Montmorenci Falls.

Baltimore, Md.—Governor Brown, president of the Traction Company, is interested in a scheme for building an electric railway from this city to Gettysburg, by way of Westminster and Littlestown. It will run along the pike, and it is expected that high speed can be maintained over it.

Williamsport, Pa.—The Vallemont Electric Railway is to be extended to Sulphur Spring, where a handsome park will be laid out and a big pavilion built for music and dancing; another attraction will be the extension of the road to the top of the mountain with a switch-back road down the north side.

Fort Dodge, Iowa.—The city council has granted a twenty-five year exclusive contract to S. T. Meservey, a local capitalist, for an electric street railway and lighting plant. The Thomson-Houston Company now has a franchise for lighting which expires in 1896, and this means that they will be shut out.

Scranton, N. J.—The Scranton Electric Construction Company will apply to the Governor for a charter. The object of the company is to manufacture and furnish electric plants of all kinds. Among those who are interested in the company are E. P. Sturgis, F. E. Platt, O. S. Johnson, W. T. Smith, F. J. Platt and Joseph C. Platt.

Cincinnati.—A new motor for use on electric cars, the invention of John A. Smith of the Mt. Auburn electric road, has been affixed to a car on that road and tested. A speed of forty miles was recorded, and the operation of the machine surprised the officials of the road and a number of press representatives who were present at the test.

Hartford, Conn.—At a recent meeting of the directors of the Hartford, Manchester and Rockville Tramway Company, the building of the line as far as Manchester and the extending of it as far as Rockville were discussed and the directors voted to build it the entire length and to have it completed and cars running before the year is out.

Reading, Pa.—Two companies are now bidding for the privilege of building an electric road from this city over the Berks and Dauphin turnpike to Womelsdorf, ten miles west of Reading. They are the Birdsboro Street Railway Company, and the Reading and Womelsdorf Railroad Company, which is a branch of the Traction Company.

Greenbush, N. Y.—Justice Fursman has appointed James H. Pratt temporary receiver of the Electric Manufacturing and Gas Engine Company, of Greenbush. The corporation was formed March 25, 1891, and for two years has been unable to meet the expenses of conducting the business or to meet its liabilities. The total indebtedness of the corporation is fixed at $47,394.42.

Chicago.—The Central Rapid Transit Company has applied for a franchise for an electric railway in outlying portions of this city. The company intend to propel their cars by storage batteries. The directors are W. W. Lowe, of Omaha; A. G. Goodman, H. C Cornell, E. K. Grant, W. G. McLaughlin, P. D. Farnsworth, Z. C. Spencer, J. W. Lasure and John E. Fitzpatrick, Chicago.

Osage, Iowa.—Since the burning of the electric light building the company has refused to rebuild and resume business unless more patronage was given it, and at a special meeting of the city council it was decided to put in the streets twelve additional arc lights. The business men have also given promise of additional support and the company will rebuild immediately.

New York.—The net earnings of the Edison Electric Illuminating Company of New York for June were $52,504, an increase of $18,306, and for the six months ended June 30, 1894, $375,644, an increase of $93,341.—The statement of the Brooklyn Edison Electric Illuminating Company for June shows net earnings of $6,182, a decrease of $928; earnings from other sources $5,604, an increase of $4,417, and amount applicable to dividends $9,687, an increase of $3,489.

Leavenworth, Kan.—The sale of the Leavenworth Electric Railway to the Leavenworth Electric Railroad Company has been confirmed by Judge C. G. Foster, of the United States District Court.—The Leavenworth Electric Railroad Company has filed a mortgage with the recorder of deeds covering the franchises and property of that company for the sum of $300,000 to the Atlantic Trust Company of New York. The mortgage is made to secure an issue of $300,000 of 6 per cent bonds of the company.

Toledo, O.—The Consolidated Street Railway Company has asked for a franchise to extend its lines so as to connect with the new electric road now in process of construction between Walbridge Park and Maumee, and with another new road from the city limits on the east side to Perrysburg.—The franchise obtained by Col. Tillotson for an electric road from Toledo to Maumee having expired by limitation, a new effort is being made to form a company that will build the road.

Allingtown, Conn.—The Poppowitsch Electric Company, organized under the laws of New

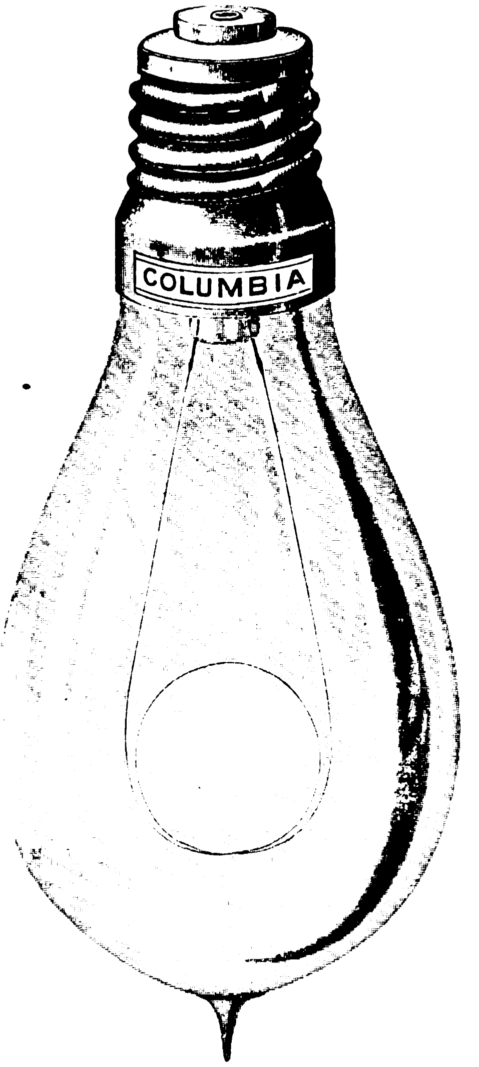
Jersey, has chosen Allingtown as a site for its factory. The ultimate object of the company is the manufacture of all kinds of electrical apparatus. The most important invention is a depolarizing compound for electric batteries called "Depolarite"—depolarite carbons, depolarite batteries and depolarite power apparatus, medical apparatus, depolarite plating apparatus and depolarite electric fishing apparatus.

Newark, N. J.—The Consolidated Traction Company intend to place flat cars on their electric line between Newark and Jersey City for the purpose of carrying freight at night.—Four suits for damages against the Consolidated Traction Company have been instituted. One for $20,000 is by John Glynn, for the loss of a leg on April 10; another by Sarah Tabore, for $10,000 for being ejected from a car; the third is by Louis Gastow, who claims $5,000 because he was put off a car, and the fourth is for $10,000 by Rocco Cohiccio, whose son Vito, five years old, was killed by a car on June 23.

Washington, D. C.—Mr. Lapham, from the House Committee on Military Affairs, has reported favorably, with a slight amendment, the bill granting the right of way through the Arlington Reservation to the Washington, Alexandria and Mount Vernon Electric Railway, along the river road between the cemetery and the river, and substantially parallel with the eastern line of the cemetery grounds.—An official order has been issued by the District Commissioners granting the Eckington and Soldiers' Home Railroad Company permission to put down an underground electric railway on North Capitol street between New York avenue and T street.

High Economy Incandescent Lamps.

After a series of exhaustive experiments covering several months, under the supervision of Mr. J. E Randall, the Columbia Incandescent Lamp Company now announces that it is prepared to furnish to its customers a superior lamp of high efficiency, in what is known as high volt lamps—100, 110 volts, etc.



The Columbia Lamp.

The filament is made by an entirely new process which enables the production of very uniform results, and also the manufacture of lamps having a much higher economy than lamps of the same voltage heretofore placed on the market. A comparative test of these lamps with lamps of other makes shows that they will maintain their candle power to a higher degree at a higher efficiency than any lamp heretofore placed on the market. While the filament is made in coiled form on account of its extreme length, this is not the special feature of the lamp, but the material from which the filament is made, making it more homogeneous and uniform in results.

The use of this lamp, the company asserts, will show a saving to the consumer in energy of from 15 to 20 per cent., and thereby a corresponding additional output to the station.

Those contemplating the use of such lamps should place their orders early in order that they may be promptly supplied.

The Westinghouse Stopper Lamp.

Catalogue No. 64 of the Westinghouse Electric and Manufacturing Company is devoted to the Stopper Lamp. Full descriptions with illustrations are given, also price lists, etc.

INCORPORATIONS.

The Elbridge Electrical Manufacturing Company, Elbridge, Onondaga County, N.Y.—to manufacture electrical appliances and apparatus, and engines, boilers and machinery. Capital stock, $10,000. Directors: William C. Ranney, Lewis B. Doman and Albert E. Doman, of Elbridge.

The North and South Electric Railway Company, Yonkers, N Y.—to construct a street surface road, about five miles in length, in Yonkers. Capital stock, $50,000. Directors: William Delavan Baldwin, S. T. Hubbard, John C. Shotts and T. H. Silkman, of Yonkers, and others.

The City Electric Company, Putland, Vt.—to construct and operate an electric road in Rutland. Capital stock. $100,000. Directors: E. A. Morse, E. M. Woodruff, J. E. Creed, H.O. Edson, James Carruthers, J. D. Hanrahan and H. Bates.

The Brooklyn Gas and Electric Company, to furnish gas and electricity for public and private purposes in Brooklyn, N. Y. Capital stock, $10,000. Directors: Chas. W. Schluchtner, Edward A. Fitts and William J. Winberg, of Brooklyn.

Stanstead Electric Light Company, at Quebec—to furnish electric light and power. Capital stock, $25,000. Incorporators: Henry Lovell, Moody B. Lovell, Charles A. Lovell and Fritz E. Lovell, manufacturers of Coaticook; Michael F. Hackett, John M. LeMoyne, Alfred N. Thompson, Henry E. Channell, of Stanstead Plain; and George F. Terrill, of Sherbrooke, Canada.

Inter-State Telephone Company, St. Johnsville, N. Y.—to maintain a telephone line from Little Falls, through St. Johnsville and Fort Plain to Canajoharie. Capital $8,500. Directors: H. L. Sutherland, O. W. Fox, John B. Snell, of St. Johnsville, and others.

At Trenton, N. J., the Central Jersey Traction Company, 2 Wall street, New York—to build and operate electric railways in New Jersey. Capital stock, $500,000. President, Frank A. Magowan, of Trenton; vice-president, E. W. Hine, of Newark; secretary, J. H. Baldwin, of Newark; treasurer, James H. Darrah, of Trenton; directors: D.N. Bayne, of New York; W. H. Swirm, of Trenton; Joseph H. Reall, of Bloomfield, and J. C. McNaughton, of Philadelphia. Mr. Magowan is also president of the New York and Philadelphia Traction Company, incorporated on the same day at Trenton, N. J., with a capital stock of $10,000,000. The system of electric roads projected by the two companies comprehends a network of roads taking in and connecting all the principal cities, towns and villages in New Jersey, as well as a trunk line by the nearest route between New York and Philadelphia. The incorporators of the latter company are Frank Macgowan and James P. Darrah, of Trenton; Joseph H. Reall, of Bloomfield; D. K. Bayne, of New York, and others.

The Defiance Light and Railway Company, Defiance, Ohio. Capital stock, $100,000. Incorporators: Samuel L Nelson, Charles E. Miley, Alvaro S. Krotz, Lawrence L. Minor and Oscar T. Martin.

ELECTRICAL PATENT RECORD.

Letters Patent Issued July 10, 1894.

ELECTRIC RAILWAYS AND APPLIANCES.

522,655. Conduit Railway Trolley. John L. Creveling, Auburn, N. Y. Filed April 5, 1894.

522,670. Danger Signal for Railway Crossings. Myron W. Parrish, Detroit, Mich. Filed Oct. 30, 1893.

522,709. Contact Shoe for Electric Locomotives. John J. Green, Boonton, N. J., assignor to the Universal Electric Company, New York, N. Y. Filed July 5, 1893.

522,710. Contact Bar for Electric Locomotives. John J. Green, Boonton, N. J., assignor to the Universal Electric Company of the city of New York, New York, N.Y. Filed Oct. 9, 1893.

522,711. Supply System for Electric Railways. John J. Green, Boonton, N. J., assignor to the Conduit Construction Company, New York, N. Y. Filed Oct. 9, 1893.

522,834. Electric Locomotive. Edward Hopkinson, Manchester, England. Filed July 21, 1891.

522,844. Trolley Ear. Charles A. Lieb, New York, N. Y., assignor to the General Electric Company, Boston, Mass. Filed April 12, 1894.

522,845. Trolley Wheel. Charles A. Lieb, New York, N.Y., assignor to the General Electric Company, Boston, Mass. Filed April 12, 1894.

522,894. Closed Conduit for Electric Railways. Charles I. Greer, Washington, D. C., assignor of one-half to Charles B. Peirce, same place. Filed April 16, 1894.

522,915. Trolley Pole. Alexander S. McBean, Montreal, Canada. Filed April 10, 1894.

ELECTRIC LIGHTS AND APPLIANCES.

522,680. Electric Arc Lamp. Moses S. Okun, New York, assignor to Theodore F. Bourne, Clifton, N. Y. Filed Sept. 21, 1892.

522,690. Electric Lamp Holder. Martin P. Meyer, Rochester, N. Y. Filed Feb. 27, 1894.

522,727. Electric Lamplighter. Josephus C. Chambers, Detroit, Mich. Filed Feb. 10, 1894.

522,790. Electric Arc Lamp. Edward F. Gwynn, Delaware, Ohio. Filed April 28, 1893.

522,896. Hanger for Electric Lamps. Henry C. Henley, St. Louis, Mo. Filed July 27, 1893.

DYNAMOS, MOTORS, ETC.

522,580. Dynamo Electric Machine. Louis Bell, Lynn, assignor to the General Electric Company, Boston, Mass. Filed Sept. 19, 1892.

522,581. Controller for Electric Motors. John B. Blood, Lynn, assignor to the General Electric Company, Boston, Mass. Filed Dec. 18, 1893.

522,820. Means for Regulating Alternating Current Motors. Edward M. Bentley, Boston, Mass., assignor to the General Electric Company, same place. Filed April 17, 1893.

522,851. Motor Safety Device. Arthur W. K. Peirce, Plymouth, Mass., assignor to the General Electric Company, of New York. Filed Oct. 29, 1892.

522,859. Insulated Armature Coil. John H. Shugg, Boston, Mass., assignor to the General Electric Company, of New York. Filed April 21, 1894.

TELEPHONE AND TELEGRAPH APPARATUS.

522,707. Telephony. Frank R. Colvin, New York, N. Y. Filed May 22, 1894.

522,892. Telautograph. Elisha Gray, Highland Park, Ill. Filed March 8, 1893.

522,893. Telautograph. Elisha Gray, Highland Park, Ill. Filed Jan. 27, 1894.

522,925. Operator's Telephone-Circuit. Thos. C. Wales, Jr., Boston, Mass., assignor to the American Bell Telephone Company, same place. Filed Dec. 2, 1893.

ELECTRICAL MEASURING INSTRUMENTS.

522,948. Electrical Measuring-Instrument. Edward Weston, Newark, N. J. Filed Oct. 3, 1892.

522,949. Watt-Meter. Edward Weston, Newark, N. J. Filed April 26, 1893.

522,950. Electrical Measuring-Instrument. Edward Weston, Newark, N. J. Filed Feb. 21, 1894.

BATTERIES.

522,836. Galvanic Battery. Louis F. Johnson, Poughkeepsie, N. Y. Filed April 7, 1894.

MISCELLANEOUS.

522,597. Electric Switch. Joseph Hutchinson, New York N. Y. Filed June 14, 1893.

522,614. Electrolytic Diaphragm. Isaiah L. Roberts, Brooklyn, N. Y. Filed Feb. 10, 1893.

522,615. Electrolytic Apparatus. Isaiah L Roberts, Brooklyn, N. Y. Filed Aug. 19. 1893.

522,616. Method of Electrolytic Decomposition of Salts. Isaiah L. Roberts, Brooklyn, N. Y. Original application filed Sept. 27, 1892. Divided and this application filed Sept. 4, 1893.

522,618. Apparatus for Electrolysis of Salts. Isaiah L. Roberts, Brooklyn, N. Y. Filed Oct. 4, 1892. Renewed Feb. 1, 1894.

522,619. Electrolytic-Decomposition Tank. Isaiah L. Roberts, Brooklyn, N. Y. Filed Nov. 25, 1891. Renewed Jan. 29, 1894.

522,632. Circuit-Closing Device. Philip J. Walsh, Jr., Philadelphia, Pa. Filed May 3, 1894.

522,664. Electric Distribution-Box. Oscar D. Kleinsteuber and Monroe A. Kleinsteuber, Milwaukee, Wis., assignors of one-third to John T. Janssen, same place. Filed April 5, 1894.

522,674. Electric Meter. Gustave A. Scheeffer, Peoria, Ill. Filed April 2, 1894.

522,694. Electrically-Controlled Whistle and Valve for Operating Same. Charles E. Ongley, New York, N. Y., assignor to George J. Schoeffel, same place. Filed Oct. 30, 1893.

522,718. Electric Heater. Harry W. Leonard, New York, Filed March 22, 1893.

522,724. Electric Synchronizer for Clocks. Ludwig von Orth, Berlin, Germany. Filed May 6, 1892.

522,733. Electric Door-Opener. Henry F. Keil, New York, N. Y. Filed Jan. 30, 1894.

522,745. Insulating Composition. James L. Truslow. Jr., Summit, N. J., assignor to Truslow & Company, New York, N. Y. Filed July 27, 1893.

522,835. Electric Crane. Edward Hopkinson, Manchester, England. Original application filed July 21, 1888. Divided and this application filed March 15, 1894.

522,837. Current-Separator. Louis F. Johnson, Poughkeepsie, N. Y. Filed April 7, 1894.

522,839. Electrolytical Apparatus. Oskar Knofler, Charlottenburg, Germany. Filed Dec. 7, 1892.

522,841. Electric Belt. William E. J. Lawler, Portland, Ore. Filed Sept. 14. 1893.

522,865. Current-Interrupter for High-Potential Circuits. Elihu Thomson, Swampscott, assignor to the General Electric Company, Boston, Mass. Filed Feb. 6, 1893.

522,918. Overhead Traveling Crane. John R. Morgan, Alliance, Ohio, assignor of three-fourths to Thomas R. Morgan, Sr., Thomas R. Morgan, Jr., and William H. Morgan, same place. Filed Nov. 25, 1893.

522,919. Electric Cigar-Lighter. Charles F. Reiff and Henry Munk, Fremont, Ohio. Filed Jan. 25, 1894.

522,920 Electric Governor. Marcus P. Schenck, Springfield, Mass. Filed Nov. 21, 1893.

522,934. Electric Cigar-Lighter. John J, Eberhard and Carl G. Schimkatt, Fremont, Ohio, assignors to the United States Electric Lamp Lighter Company, Detroit, Mich. Filed Sept. 25, 1893.

RE-ISSUE.

11,428. Electric Signaling Apparatus. John P. Coleman, Swissvale, Pa., assignor to the Union Switch and Signal Company, same place. Filed Dec. 5, 1893. Original No. 395,315, dated Jan. 1, 1889.

ELECTRICITY.

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EDITORIAL NOTES.

Alfred Vail and S. F. B. Morse. As stated in a previous issue, the succeeding numbers of Mr. Stephen Vail's historical narrative of the evolution of the telegraph continue to increase in interest. In this issue we have Morse quoted as saying just before his death, "The one thing I want to do now is justice to Mr. Vail." Perhaps the weakness attending his coming dissolution prevented the fulfilment of this wish; but certain it is that it was not done, and Vail's name, but for the memory of a comparatively few now living, and the story of his life which has come down rather as tradition than as history, would be comparatively unknown. In fact it is openly claimed that certain publishers, usually regarded as reputable, have falsified history simply because of pressure having been brought to bear upon them, which was creditable neither to those who gave rise to it nor to the publishers against whom it was directed. This spirit of unfairness against Vail, which seems almost inexplicable, is more widespread than any one would suppose who had not been brought face to face with it. It even permeated the authorities at the World's Fair. The writer distinctly remembers that an attempt was made to commemorate Vail's connection with the telegraph, and large medallions of both Morse and Vail were made for the adornment of Electricity Building. That of Vail at least was finally hidden away, and the public never saw it.

The only claim made by the friends of Morse that has the least odor of validity is that there was an agreement between them that the inventions of Vail should be patented by and considered as belonging to Morse. This Vail admits, and accounts in this way for his not having asserted his claims to his individual inventions. It is common practice now for companies when absorbing, by purchase or otherwise, the inventions of others to insist upon giving to the acquired invention their own names instead of that of the inventor. We know of a case where an inventor endeavored to avoid this suppression of his name, and when selling to a company which bore a prominent inventor's name stipulated that no other than his own name should ever be attached to his drill. The stipulation was adhered to for a while, and during that time no letter referring to this drill left the office without designating the drill by its inventor's name, but that has long since passed, and the drill would not to-day be known by its proper name, another having usurped the honor. Now this may be business—we know it is customary practice—but it is not honorable and confuses history. Should this particular invention ever reach the importance that the telegraph has, it would be as difficult after the lapse of a decade or two to assign credit to its rightful owner as it is now to establish Vail's part in the electromagnetic telegraph. The two cases differ only in this, that in the case of Vail he agreed to have his inventions known as Morse's while the latter inventor insisted that his should bear his own name. Vail did not, however, by his voluntary act assign away the credit due him. In fact he could not so assign it, for if he really did invent the telegraph, or bring it into a commercial state, the fact must remain unaltered by any act of his own or anybody else.

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Mr. Garfield and Mr. Coffin. Will some of our readers be kind enough to explain why it is that since Mr. Garfield's resignation was accepted Mr. Coffin has been kind enough to recommend the former gentleman highly for a number of positions outside the electrical business at the same time that he was trying to convince a prospective employer in the trade that "Mr. Garfield is one of the what-has-beens, has gone to seed, and is utterly useless in the business"? Does Mr. Coffin fear that Mr. Garfield will use the knowledge gained through years of close confidence to his (Mr. Coffin's) detriment? If so, what has Mr. Coffin done that he dreads to have known? As regards Mr. Garfield, the fact is he is in his prime, possessed of all his mental and physical vigor, and a good deal farther from an attack of rattles or paresis than his present superior officer. He is one of the shrewdest traders ever connected with the T.-H. Company, knows the weak spots, the disaffections existing, in all the local T.-H. companies in New England, and if he sets himself about it, as he doubtless will, he can clean out half the T.-H. apparatus now in use in that section within two years. It is as well to write history to-day as a year hence, and here is some: Mr. Garfield fell from the good graces of Mr. Coffin and was sacrificed through the continued attacks upon him forced into Coffin's ear by Mr. B. E. Sunny and Mr. W. J. Clarke.

And it must in justice be admitted, all other things aside for the present, that Mr. Garfield is the only one of the lot whose loyalty to Coffin never wavered, who stuck to him and worked in his interests faithfully to the last.

The band of the forty thieves has dwindled down to a hapless band of three or four who are still struggling for position as strenuously as when there were positions worth struggling for, Messrs. Greene and Clarke, we believe, being the latest rivals, the former having won.

But Alibaba's star has set.

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A Railway Rate War. The city of Savannah, Ga., probably has the cheapest street railway fares on record as the result of a war between the competing companies. Passengers can ride a distance of over a mile on one line for 1 cent. On another line tickets can be obtained at the rate of 1½ cents for the round trip. On other lines the fare is 3 cents a trip. The only line upon which the fare remains at the rate of 5 cents is the old Belt line.

The local papers voice the spirit of popular rejoicing over this condition of affairs, and express the opinion that enough more people will ride at the low fares to make the net profits of the road larger than when the standard rate of 5 cents was charged.

The situation is an interesting one from several points of view. There is a charming inconsistency in the remarks of President Harriman of the City and Suburban, one of the warring lines:

> "We have actually taken in more money during the last two months than during the same months last year. The increase in travel has been very nearly double what it was. This old story about Savannah people not caring for the coppers and being as willing to pay 5 cents for a ride as 3 cents is an exploded theory. . . . We are in this fight for business and we are here to stay. It is only a question as to which line can hold out the longest, and there is no doubt in my mind as to which line that will be. We were here first. The other people came in and built roads paralleling our lines, and which by reason of competition made both lines unprofitable."

Here we have first a declaration that it is more profitable to run a railroad in Savannah at a 3 cent fare than at a 5 cent fare; second, a declaration that it is merely a question of which company can hold out the longest.

The second statement is sound truth, the former the veriest nonsense.

There are too many railroads in Savannah, even providing for all possible increase in population for the next quarter of a century. That one or more must go to the wall is inevitable.

The company having the best bank account will probably be the survivor, and the others must surrender.

A more sensible method of competition, we think, would be a struggle as to which could offer the best accommodations to the public for the standard rate of fare.

As we understand the situation in Savannah, the City and Suburban Company, the first in the field, provided an abominable mule service, refusing to adopt the trolley until forced to do so after the establishment of the Electric Company.

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The Canal Contract. There is every reason for believing that the famous canal contract granted to the Cataract General Electric Company by Mr. Edward Hannan, Superintendent of Public Works of this State, will be declared void. It is good opinion that the matter will not even go before the Supreme Court, and that the Cataract Company will lay down without a prolonged struggle.

Deputy Attorney-General Parsons has so expressed himself since his attention was called to the matter. He is of the opinion that by the terms of the contract the State is placed in the position of leasing State land to a private corporation, which is clearly an unconstitutional proceeding.

The Attorney-General will soon be requested officially to take up the question, before the Cataract Company shall have made any move toward occupying the land.

This is as it should be, and ELECTRICITY, as usual, wins.

If the Niagara people can profitably transmit electric power to Albany, or to Seattle, let them do so and pay for their right of way. The State owes them nothing.

It is almost a certainty that the company can reap sufficient financial reward for its enterprising undertaking at the Falls. It should not be helped by a gift from the State to compete with established plants, but should be compelled, as it will be, to stand on its own bottom.

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An Explanation. At intervals some one or other of our foreign contemporaries prints a few words of truth in regard to the General Electric Company and its situation in this country. The last issue of *Industries and Iron* is the latest example to attract our attention. As a rule, however, these contemporaries seem utterly ignorant of the exact status of affairs in the trade on this side the water. Reference is occasionally made to our campaign against the General Company, showing surprise and hazarding the opinion that the attack must be a personal one. Of course it is nothing of the kind.

A few words of explanation are perhaps due to our foreign readers. Our English cousins are at present being humiliated by the exposure of the dishonorable methods by which Messrs. Woodhouse & Rawson have disgraced the trade in their own country; and while the methods of this concern were not like those of the General Electric Company in every detail, the main object was the same in both cases, to wit, the sale of worthless securities to the public. Our English friends ought, therefore, to partially appreciate the American situation.

It must not be supposed that because ELECTRICITY is the only American journal to attack the General Company with any vigor it stands alone in its opinions. We are backed by 99 per cent. of the trade. The reasons why our contemporaries have not joined in the fight are possibly the same reasons which led the English papers, with but a single exception, to withhold criticism of Messrs. Woodhouse & Rawson until they had done all the damage possible, were on the verge of bankruptcy, and had no further favors to bestow.

There are of course many points of difference in the careers of the two concerns referred to. The General Electric Company, it will be remembered, was formed two years ago. It was merely the culmination of a plan, evolved by Mr. C. A. Coffin several years earlier, to control absolutely the entire manufacturing and selling electrical business of this country. This was the objective toward which every energy was exerted, and in the attempt the laws of business decency and fairness were utterly ignored. It was a campaign of blackmail and extortion from the first. Business enterprises were wrecked without consideration for minority stockholders, and the entire army of commercial and manufacturing workers in the trade were notified that they must get out to make room for the people who claimed to own the earth.

ELECTRICITY'S campaign has been made, not against individuals, but against the company and its methods, and in defence of the right which every man should enjoy, to engage in any honorable business he chooses whether his capital is $1,000 or $1,000,000. That Mr. Coffin could not be divorced from the company in our criticism is well known in this country. The plan was his, the methods were his. His power was absolute. He was the mainspring of the entire machine. Coffin was the company and the company was Coffin. Others stepped into the management of affairs only when ELECTRICITY had won its fight when both Coffin and the company were thoroughly beaten.

There will be a few more convulsive shudders of the dying monster, and we shall attend the funeral—not as a mourner nor yet in a spirit of jubilation, but as a philosopher. And when it is all over ELECTRICITY will be the brightest, the most urbane trade paper in the world, the apostle of peace and good will.

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WHILE the endless controversy proceeds as to who was the first man in the electrical business to do this or that, it is proper to record that Mr. Philip Chillyday Ackerman, of the American Electrical Works, was The First Man to sell the Ft. Wayne Electric Corporation a bill of goods.

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The General Electric Company is now doing a gross business of about $1,000,000 per month, profits not stated.
—*Boston Herald.*

PURE humbug. The General Electric Company's gross business is now at the rate of less than nine millions for the year. Profits are not stated because there are none, business being conducted at an actual loss.

You Can Tell an Ass by Its Bray as Well as by Its Ears. Our foreign contemporary, the *Electrician*, is one of the most valued of our exchanges, but once in a while it slops over in such a manner as to make its friends blush for it. Probably on such occasions the editorial work has been done by the office boy or the cat. It is so used to indulging in pedagogic criticism of this and that which does not quite meet with its approval that it has acquired the feeling that all that is required to change the facts is for it to deny them and substitute other statements in their place. These "other statements" thereupon immediately become facts, and those which were no longer are. In its issue of July 6, it commits one of the most flagrant abuses of the kind referred to, evidently incited to the same by a description that appeared in these columns not long since of a new alternating current generator in which stress was laid upon the fact that by properly shaping the pole pieces of the inductor the machine gave rise to currents that approached very closely to true sine curves. Here is the way it effuses:

> "It looks as if some alternator builders were really thinking seriously of following Mr. Blakesley's historic suggestion, that they should build their machines to give 'true sine curves,' in order that the theory of the machines might correspond with his geometrical methods. The practice has recently become extremely popular in America, where a considerable number of manufacturers are advertising the possession of a 'true sine curve' as a valuable feature of their alternators. The grounds upon which such claims are based do not always strike one as being adequate, and one may be forgiven for harboring a little doubt about the purity and excellence of the 'sine' which may be tapped at the terminals. Whether the alternator builders are striving to impart some fresh objective value to their machines, or whether they are graciously trying to get their machines into step with the effusions of the mathematicians, or whether those same effusions have acted injuriously on their otherwise practical brains, we are unable to say. Probably an alternator with a true sine curve, even though it may disdain to run in parallel with a machine having a more bactrian characteristic, is little or no better intrinsically, from a commercial point of view, than the less highly-bred article. But the former has the dignity of hobnobbing with the text-book mathematicians, while the latter knows only the greaser and the switchboard attendant. Some day a steam engine builder may advertise a steam engine guaranteed to give 'true hyperbolic expansion' and a text-book indicator diagram. Then the mathematicians will swarm around that engine, and with tears of joy they will get it coupled to the alternator with the 'true sine curve.'"

What utter bosh and nonsense this is! If it were necessary to pad out their columns, why not do it with some humorous production such as the *Electrician* has shown itself so fully capable of grinding out, instead of stultifying itself in this way. Will our contemporary dare put itself on record as believing that a *bactrian* curve is more economical either to generate or to transmit?

The term "bactrian" being one with which we were not very familiar, we have been at pains to look it up in the dictionary. We find that it is a camel having two humps, and on looking up the word camel, we find it defined as "A large ruminant used in Asia and Africa for carrying burdens and for riding. The camel is remarkable for its ability to go a long time without drink." From the statement that "the former (that giving a true sine curve) has the dignity of hobnobbing with the text-book mathematicians, while the latter (a machine giving a two-humped camel curve) knows only the greaser and the switchboard attendant," we judge that the editor has exceeded his limit of abstaining from drink, and having yielded to temptation, has fallen by the wayside. If that be true, we have only kindness and pity in our hearts for him, believing that it is a Christian duty to lift up the fallen brother and encourage his steps to a better life. But if he be not fallen, then there is a possible explanation of the miserable display made by Great Britain in the electrical department of the World's Fair, and the attitude of our contemporary towards the Fair—that it did not care to put in competition its own machines having "bactrian" characteristics, familiar "only to the greaser and switchboard attendant," with those of American make that had "enjoyed the dignity of hobnobbing with the text book mathematicians."

Perhaps our contemporary will resort to the expedient of claiming that the editorial in question was merely a slip of the pen, as another journal recently did when trying to instruct us in mathematics. Its statement was that if our system of linear measure were based on π, then the ratio of the circumference of a circle to its diameter would be unity. On our being unable to see just how this could be true, the contemporary in question denied its intention to make such a statement, and attributed it to a *slip of the pen*. We think the *Electrician* and the *Electrical World* can shake hands. They are both demagogues, both breathe the same atmosphere, both draw pap from the same breast, and both occasionally show symptoms of *locomotor ataxia* by slips of the pen.

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> General Electric is on the up-track again. The company has made some valuable contracts, and when these are executed General Electric directors will resume dividends on the preferred stock.

THE above is a sample of the stuff Mr. Coffin is sending out to financial editors, and which not only the silly ones, but some who ought to know better, are using.

The Chicago elevated railway contract, widely proclaimed as a million-dollar job, amounts all told to a little less than $300,000. Allowing a profit of 20 per cent., we have in this, the only profitable contract of the year, $60,000 towards repairing the $16,000,000 deficit in the assets of the company.

Do the editors who are printing this not know how many dividends on the preferred have been passed, that they are cumulative, and that over $16,000,000 will have to be earned or donated (or perhaps written in to the company's assets) before any dividend of any kind can be paid?

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The Electrical World, in its issue dated July 21, publishes a column of matter in regard to the Ft. Wayne coup (not *coup d'etat* as our contemporary calls it), taken from the Sunday *World* of the 15th. Every fact therein mentioned was printed in ELECTRICITY of June 13, just five weeks earlier. Brother Johnston would better return at once or he will find his paper as far behind the times as the red paper with the long name.

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Our esteemed contemporary, *Electricity* (London), says of us:

> In an editorial, Messrs. Houston and Kennelly's estimates as to the distance to which Niagara power can be economically transmitted are severely pulled to pieces. Our contemporary seems to have a strong dislike to Mr. Charles Albert Coffin, who, it appears, has joined the General Electric Company. Our contemporary also gives portraits of him taken in the years 1878 and 1892; as he is not an ugly man, the reason for the latter procedure is not clear.

We have no dislike for Mr. Coffin, but for his acts. He has not joined the G. E. Company. The trouble is that he has disjoined and rent asunder, not only his own company, but the entire electrical trade of this country. We printed his two portraits simply to show the evolution of the man. He is not indeed ugly, and he wears a million-dollar smile, which we regret no photograph can reproduce.

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> "ELECTRICITY, a trade journal that has persistently attacked the General Electric Company for the reason, it is said, that the company has persistently refused to favor that paper with advertising."

THE above is from the *Journal of Finance*. ELECTRICITY, under the present management, has never solicited the advertising patronage of the General Electric Company. We have, however, given them more advertising than all other electrical papers combined. And the end is not yet.

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THE General Electric Company is like a fool chicken flopping around in the grass with its head cut off. It is dead and don't know it.

BULLETIN.

Change No. 2,222, New Series.

The executive committee has decided to abolish the few remaining departments and to change the selling system. The sales committee will no longer have authority in these matters. Capt. Eugene Griffen will have entire charge of the selling business of the company. Mr. S. D. Greene will be his first assistant. The abolition of the departments reduces Messrs. W. J. Clarke and J. R. McKee to the ranks, and the latter will probably retire.

Under the new arrangement it would seem that Capt. Griffen will have more power in the company than Mr. Coffin.

Bands Will Play.

And There Will Be Banquets and Speeches.

(From the McKeesport Times.)

The new electrical works of the Westinghouse Company, east of Brinton Station, will be dedicated next September. Preparations are being made for a red-letter day, as the company will not spare energy or money for its success, it being intended that a large sum of money will be spent to make it so. It has been arranged to have the dedication take place during the National Encampment, and all the veterans will be given an invitation to attend.

President Cleveland and many other notables connected with the National Government will be invited, and Hon. Thomas B. Reed will be asked to make an address. The wives of the Westinghouse employees in the Pittsburg shops will serve the dinner, and it will be spread on tables in the upper stories of the new Brinton works. There are to be a number of bands of music; the decorations will be worth going miles to see. These works are perhaps the largest electrical works in the world.

HOUSTON'S ELECTRICAL DICTIONARY.

Third Edition.

A FRIENDLY CRITICISM.

The third edition of Prof. Edwin J. Houston's "Dictionary of Electrical Words, Terms and Phrases" has just been issued from the press of the W. J. Johnston Company, Limited. It is nicely printed on good paper.

The trade catalogue feature, which so marred the first two editions, is not quite so conspicuous in this volume as in the others, the advertisements of the W. J. Johnston Company occupying only four pages, as against ten in the second edition. Four, however, are more than good taste would allow.

The book has not been made over, the additional matter having been inserted in the form of an appendix of about 100 pages, and the body having been printed from the same plates as the second edition, without alterations or corrections. This is hardly fair to the purchasers of the Dictionary. The new matter should have been issued in a separate volume at a low price as a supplement, until such time as the author could make a thorough revision of the entire text. The author promises this for the fourth edition, if one is required. We think it will be, not for the sake of additions of words, terms or phrases, but of getting rid of scores and hundreds of needless infantile definitions and cross-references. The fourth edition should occupy fewer pages than even the second edition.

In his preface to the latter, the author offers an apology for the incompleteness of the first edition. The apology is not required for the volume before us. It is the most complete work in the English language, if one work may be said to be more complete than another, and if a work dealing with mhos, gausses, microfarads, bicrofarads, begohms and begobs can be said to be in the English language.

Prof. Houston should have stuck to the principle enunciated in the preface to the first edition: "New words are often coined, although others already in existence are far better suited to express the same ideas."

It is not, however, for the author's definitions of *words* that we care to offer criticism, but with the excessive padding, i. e., the definitions of phrases made up of simple words already defined elsewhere in the book, and with the countless cross-references. Many of the former are useless now even to boys in knickerbockers; the latter could be done away with entirely by an explanatory note and a few examples of the plan of arrangement, occupying not over a half page. Under the letter E alone there are about ten pages of these cross-references, nearly all a waste of space.

We cite a few examples of the needless definitions of phrases:

> Pull, Door-bell, Electric.—A circuit closing device attached to a bell-pull and operated by the ordinary motion of the hand.

Was it necessary to explain that bell-pulls are not usually operated with the teeth or with the feet, but by the ordinary motion of the hand?

> Railroads, Electric, Continuous Overhead System of Motive Power for.
>
> Railroads, Electric, Continuous Surface System of Motive Power for.
>
> Railroads, Electric, Continuous Underground System of Motive Power for.

Each one of these is followed by ten or twelve lines of definition, and the cross-reference (See Railroads, Electric, Continuous Underground System of Motive Power for), etc.

> Armature, Tri-Phase.
>
> Armature, Two-Phase.
>
> Flat-Iron, Electric.—An electrically heated flat-iron. A hollow flat-iron provided with a suitably placed electric heater. (See Heater, Electric.)

The author should also have told us what a flat-iron is, what its uses are, and who discovered it, with illustrations of the various styles of flat-irons at rest and in motion.

Here are a few examples of padding of another kind:

> Push.—A name sometimes applied to a push-button or to a floor push. (See Push, Floor, Button, Push.)
>
> Push Button.—(See Button, Push.)
>
> Arc, Frying of.—A frying sound attending the formation of a voltaic arc when the carbons are too near together. (See Arc, Hissing of.)
>
> Arc, Hissing of.—A hissing sound attending the formation of voltaic arcs when the carbons are too near together.
>
> Arc, Noisy.—A voltaic arc the maintenance of which is attended by frying, hissing or spluttering sounds.
>
> Arc, Quiet.—A voltaic arc which is maintained without sensible sounds.
>
> Arc, Roaring of.—A roaring sound attending the formation of a voltaic arc when the carbons are too near together and a very powerful current is used.
>
> Arc, Spluttering of.—A spluttering sound attending the formation of a voltaic arc.

Under "Arc, Frying of," we are told the cause is probably the same as that of hissing; and under "Arc, Hissing of," that "the cause of hissing is not entirely understood."

We fear that the recollection of the terrible experiences with Prof. Thomson's 8 light machine in the Philadelphia bakery in 1879 are still fresh in Prof. Houston's mind; else why should he thus enumerate all the different miseries, or rather all the different names for the one misery, which arc lamps cause to their users.

So much for the sins of commission, the examples cited being only a few out of hundreds.

It would seem that with all the care exercised to get in every word, term and phrase ever heard of in the science, and with the author evidently preparing the work at so much per page, with carte blanche to make as big a book as possible, nothing could have been omitted. Yet such is not the case. There are several startling omissions, a few of which we will mention, trusting that they will find a place in the fourth edition, even if a few of the "Arcs, frying, hissing, spluttering or noisy," have to be left out to make room.

We have looked in vain under H, K and T for any reference to

> Hous-Kennooley Tree, The.—The tree in which unit-sharks are wont to sing. (See Shark, Unit. Unit Shark, see.)

And also in vain under U and S for

> Unit-Shark, The or A.—A bird which is wont to sing in the Hous-Kennooley tree. (See Tree, Hous-Kennooley. Kennooley, Hous, Tree. Hous, Tree, Kennooley.)

We also fail to find, after reading the entire Dictionary through, either of the following phrases, which ought to be well known to the author though not familiar to the common run of readers:

> Papa Won't Buy Me a Bow-wow.—A vulgar expression, supposed to express Papa's aversion to Poodle Dogs. It would be preferable to say Poodle Dog instead of Bow-wow. (See Bow-wow, Papa Won't Buy Me. Papa, Bow-wow, Me, Won't Buy, A. Won't, Bow-wow, Buy Me a Papa. Buy, a Me, Papa, Won't, Bow-wow.
>
> Who Struck Billy Patterson?—A query often raised but never answered. It would be preferable, being more dignified, to substitute William for Billy. Perhaps this would please the gentleman better, and he would answer the question himself.

NOTE.—The Patterson here referred to is Billy (William) Patterson, and not Alec (Alexander) Patterson, who sells Phenix Glass. (See 42 Murray Street.)

We submit that we should have been told who struck Billy Patterson, why he was struck, under what conditions, and just how much he (who?) struck him (Billy Patterson) for. If Billy Patterson was an electrician, as he was doubtless, getting struck being a common occurrence in this trade, certainly no Dictionary can be complete without giving the public the information asked for.

The actual *defining of words* in Prof. Houston's Dictionary is well and conscientiously done, and it is easily the standard work of the English-speaking world. Vigorous use of the blue pencil in the fourth edition will render even the "friendly criticism" asked for unnecessary.

B. E. G.

CORRESPONDENCE.

New York, July 20, 1894.

The W. J. Johnston Company,
Postal Building, New York.

Gentlemen: Please send us copy of third edition Houston's Dictionary for review, and oblige yours truly,

B. E. Greene.

New York, July 21, 1894.

Electricity Newspaper Co.,
6 Park Place, New York.

Gentlemen: This work has not yet been published.

The W. J. Johnston Co., Ltd.,
A. C. C.

WAS MOSES AN ELECTRICIAN?

Or Were the Possibilities of the Fluid a Divine Revelation in the Days of the Prophets?

BY C. B. WARRAND.

There is nothing new on the face of the earth, and there is no doubt that electricity was well known to the Israelites, and probably to the Phœnicians. The first record of electrical phenomena is as old as the Ten Commandments. Moses, when he received the stone tablets on which the ten commandments were written the second time, built a box out of fir, not the common cedar or any other native wood, but fir wood which had to be imported by Phœnician merchants from the southern part of Europe. Was this choice accidental, on account of the great value of the resinous wood, or was it the choice of the best known non-conductor among the great number of various timbers?

Moses had the fir box lined inside and outside with beaten gold, which converted the ark of the covenant into a very expensive but very perfect Leyden jar or storage battery for electricity. As gold is one of the best conductors of electricity was the choice of gold again on account of its value, or was it an inspiration or revelation? So much is certain, that if Edison or Tesla had lived in those days they could not have improved on the choice of material, and the result was a powerful Leyden jar.

How was this Leyden jar charged? is the next problem. A fire of material rich in carbon was kept burning on top of the ark of the covenant, and during daytime a tall column of smoke guided the twelve tribes of Israel through their wanderings, and at night a tall flame was equally as well seen by them. Now carbon is a good conductor of electricity and the particles of carbon floating in the smoke would conduct sufficient electricity to highly charge the Leyden jar. At least the current of electricity would be amply strong, so that if a hand were held toward the ark of the covenant sparks would result. That this was done by Moses at different times is a matter of record, and that he could always depend that his faithful Levites would obey his instructions to the letter and have the jar always charged.

After Moses' death his brother Aaron took the matter in hand and greatly improved the electrical power of the strange battery. He had the ark of the covenant placed in the temple, he had it surrounded by poles 50 ells high, or 150 feet. These poles were covered with beaten gold and gold chains were hung from the poles to the ark of the covenant, which made a very expensive but very complete and powerful electrical connection. In a country where electrical storms are as frequent and as powerful as in Palestine, at an elevation of 600 feet and a reach of 150 feet of the best conductor, an abundant supply of Franklin's electricity would necessarily always be on hand.

It is very likely that Aaron knew nothing of amperes, ohms or volts, otherwise his two sons never would have monkeyed with this powerful apparatus and they would not have been killed by fire breaking out of the ark of the covenant and killing them without any wounds or burns appearing on their body.

Any coroner's jury of to-day, if it were to sit on an inquest over the body of Aaron's sons, would at once bring a verdict of death by a discharge of electricity.

Aaron knew this power, and to make it effective all he had to do to deal death from this apparatus was to remove the costly camel's hair carpets, which are almost perfect non-conductors of electricity, and make the culprit stand on terra firma; death would result instantly by fire breaking out and leave no wounds or burns to account for their death. That several members of revolting tribes of Israelites were thus electrocuted is also a matter of record in the Bible.

Solomon in building his temple advanced one step further; he found that copper would do as well as gold. He had the temple covered with copper, and copper waterpipes led into the cisterns inside the temple. On the temple, or rather on its roof, a number of gilt spears were placed in vertical positions, ostensibly to scare off the birds and to keep them from defiling the temple; but these spears were several cords high, or from 16 to 24 feet. Such a height would hardly be necessary for scarecrows but it was ample to load the roof, waterpipes, etc., with a powerful current of electricity.

Franklin, the electric chair in the State of New York, as well as the discovery of the Leyden jar itself in Leyden, Germany, are all back numbers. History only repeats itself, whether recorded or not.

An English View Which Accords With Our Own.

The elaborate speculations which American electricians have been making during the past few weeks as to "the distance to which Niagara water-power can be economically transmitted by electricity"—when they have got it—strike one as being not a little premature. There is a ludicrous resemblance to betting on the future jumping performances of an unhatched frog. This is all the more the case, because it is by no means certain that even in the event of the hatching being successful, there will not be anyone anxious to have the creature jump very far, or to jump at all in their direction. One pair of mathematical speculators, arguing on certain convenient assumptions, arrived at the conclusion "that the power of Niagara Falls can be transmitted to a radius of 200 miles cheaper than it can be produced at any point within that range by steam engines." Next comes a learned doctor who disputes the others' assumptions, invents his own, and concludes that the economical distance depends on several coefficients but is never so great as 200 miles. Several other writers take up the theme, arriving at various conclusions. Looking at the matter from a common-sense point of view, it would appear that to expect to arrive at any general formula for the radius of economical transmission is simply ridiculous. The special requirements of the consumer, the character of the route, the ever-changing question of prices, all these affect the details of the problem in a way which must hopelessly baffle any useful general investigation.—*The Electrician.*

THE DEVELOPMENT OF THE ELECTRIC TELEGRAPH.—IV.

BY STEPHEN VAIL.

Mr. William Baxter, the assistant of Alfred Vail at the time, 1837-8, an apprentice to the Speedwell Iron Works, and who in later years became widely known as the inventor of the Baxter Steam Engine, some eight or ten years since wrote of the period when Alfred Vail and he were in their locked room, making a practical commercial success of the crude, imperfect and laborious system which had been handed over to Mr. Vail by his partner, Morse, for entire reconstruction. He said: "Alfred Vail was singularly modest and unassuming, while Prof. Morse was very much inclined to insist on the supuriority of his own plans and methods—if for no other reason, *because* they were his own. As we all looked upon him with the respect due to a Professor, we were at first quite willing to defer submissively to his dicta. It resulted from this that the first machine which was constructed at Speedwell was substantially a copy of the original model, in a more symmetrical and practical form.

"As we became acquainted with Morse, it became evident to us that his mechanical knowledge and skill were limited, and his ideas, in matters relating to construction, of little value. As the weak points in the apparatus were, one after another, developed, Alfred began to draw upon the resources of his own wonderful power of invention, in substituting practical and commercially valuable mechanical combinations for the more or less impracticable designs of Morse.

"We found, for example, that the pencil of the recording apparatus frequently required sharpening, and that when freshly sharpened it made a different mark from that made by a worn point, which tended to render the record obscure and difficult to decipher. Alfred contrived a fountain-pen that made a uniform line. This device, however, was not satisfactory to him as it threw the ink in all directions when jerked by the sudden action of the magnet, and he spent some time in diligent study in the endeavor to devise a remedy.

"He was a mechanical draughtsman of surpassing skill, as is fully attested by some of his work still in possession of his family. He brought to me one day, after working for an hour at his drawing table, a sketch of a new marking device, in which a vertical motion was given to the lever instead of the transverse movement which had hitherto been employed. We constructed the new lever, and thus, *for the first time*, produced a register capable of making *dots*, *dashes* and *spaces*.

"Alfred's brain was at this time working at high pressure, and evolving new ideas every day. He saw in the new characters the elements of an alphabetical code by which language could be telegraphically transmitted in actual words and sentences, and he instantly set himself at work to construct such a code. His general plan was to employ the simplest and shortest combinations to represent the most frequently recurring letters of the English alphabet, and the remainder for the more infrequent ones. For instance, he found, upon investigation, that the letter "e" occurs much more frequently than any other letter, and accordingly he assigned to it the shortest symbol, a single dot (·). On the other hand "j," which occurs infrequently, is expressed by dash, dot, dash, dot (— · — ·). After going through a computation, in order to ascertain the relative frequency of the occurrence of different letters in the English alphabet, Alfred was seized with a sudden inspiration, and visited the office of the Morristown local newspaper, where he found the whole problem worked out for him in the type-cases of the compositors.

"In this statement I have given the true origin of the *misnamed* 'Morse' alphabet, the very foundation and cornerstone of a new system, which has since become the universal telegraphic language of the world."

We have before cited the successful experiments at the Speedwell Iron Works on the 6th of January, 1838, and a few days later, upon January 11, and the purposes of this writing requires no further mention of the incidents following this period in the history of the invention.

Mankind, in the abstract, gives but little thought, and perhaps cares less, as to the individuality of those who may have contributed most largely to its pleasure, comfort and progress, satisfied generally to enjoy the results of the skill, labor and tireless perseverance of others, and absolutely indffierent as to whether honor, fame and profit have been rightfully bestowed or not. Owing to the terms of the contract Alfred Vail made with S. F. B. Morse, in September, 1837, he was debarred from having any recognition accorded to anything *he* might accomplish in the development or improvement of the crude ideas and apparatus which comprised, at the time, all there was in the Morse system of telegraph. All that *he* might do must be, for the common benefit of the patentees, and must be known only as a feature of the "Morse patent."

Unfortunately, his life ended before he had reached the time when, in justice to himself and with honesty towards his colleagues, he could claim his share of the high honor, fame and glory that had been showered upon Morse alone. He died in January, 1859, long before the patents for the telegraph had expired, and while litigation of an extensive character with infringements was still under way; conditions which prevented him, not only as confidential associate of Morse, but as co-proprietor in the patents, and as a matter of policy and justice, from setting up a claim which might have been used with telling effect against the validity of Morse's patent.

Mr. Vail, when urged by friends to assert his rightful claims publicly, always replied, "I am confident that Prof. Morse will do me justice." Misplaced confidence—for from the time of Alfred Vail's death, not only was no disposition shown by Prof. Morse to accord his deceased associate any of the credit rightfully due him, but it would seem as if *his inclinations were all to the contrary*. In support of this assertion, unpleasant as it is to make, the following incident, of the truth of which there can be no question, for it relates to facts of record, is in this connection cited: On the evening of the 10th of June, 1871, a magnificent reception and banquet was tendered Prof. Morse by the principal citizens of New York, at which Chief Justice Chase presided. In the course of his address, delivered at the Academy of Music before an audience that thronged that immense edifice, and lasting some hour or more, Prof. Morse, referring to his invention, said: "In 1837, according to the concurrent testimony of many witnesses, it lisped its first accents, and automatically recorded, a few blocks only distant from the spot from which I now address you. It was a feeble child indeed, ungainly in its dress, stammering in its speech; but it had then all the distinctive features and characteristics of its present manhood (?) It found a friend, an efficient friend, in Mr. Alfred Vail, of New Jersey, who with his father FURNISHED THE MEANS to give the child a decent dress preparatory to its visit to the seat of government."

"Furnished the means!" This was all that the aged inventor, almost on the verge of the grave (for he died within a year), in the presence of that vast audience, and with the knowledge that his words were to be telegraphed broadcast over the country, could find it in his heart and conscience to say of the great part filled by his dead associate and friend, Alfred Vail, in the grand success that had come to his crude, impracticable device! It is inconceivable how that old man, fully aware of all that he owed (and, too, that the world owed,) to Alfred Vail, could stand before that world and deliberately take to himself all the honor, credit and renown that he knew did not belong to him alone. He did all this and more.

Four weeks prior to the day of his death, a member of Alfred Vail's family sat for two hours at his bedside, and there was told, not once only but several times, that "the one thing I want to do now is justice to Mr. Vail." He passed away, but to this day no evidence has yet been disclosed that he did anything to sustain his statements. Much documentary evidence, as well as the testimony of those cognizant of the facts concerning Alfred Vail's connection with and part in the real "invention" of all that constitutes the so-called "Morse" telegraph of to-day, and as well since the winter of 1837-38, exists to sustain all of the claims that are made for his recognition, as one entitled to a *full share* of the credit for *all* that is involved in the "Morse" patent.

Prof. Franklin L. Pope has written in the *Century Magazine*: " . . . Not a single feature of the original invention of Morse, as formulated in his caveat and repeated in his original patent, is to be found among the essential constituents of the modern apparatus. Prior to 1837 it embodied the work of Morse and of Henry alone. From 1837 to 1844 it was a combination of the inventions of Morse, Henry and Vail, but, as we have seen, the elements contributed by Morse have gradually fallen into desuetude, so that the essential telegraph of to-day and the universal telegraph of the future comprises *solely* the work of Joseph Henry and Alfred Vail. The grandeur of Vail's conception of an alphabetical code based upon the elements of time and space has never met with the appreciation which it deserves. Its utility is not confined to electric telegraphy. It is used to signal by intermittent flashes of light between far-distant signal stations of the Coast Survey, and between the different vessels of a fleet; it is sounded upon whistles and bells to convey intelligence to and from steamers cautiously feeling their way through the obscurity of fogs, and in fact nearly every day brings to notice some new field of usefulness for this universal symbolic language."

Difficult indeed is it to uproot long existing beliefs and prejudices, and it is not the expectation that it is in the power of the writer, or any other, to eradicate the extensive and unjust impression which prevails, that S. F. B. Morse was the *real* and *only* inventor of the telegraph, but one of the hoped-for results that his and others' agitation of this subject may secure, is that the disposition of writers and speakers, when alluding to the invention of the telegraph may be more in the direction of a proper recognition of Joseph Henry and Alfred Vail than it now is or has been.

Only very recently a writer upon the subject made the remarkable statement that "the probability is that if Morse had not found Alfred Vail he would have hit upon somebody else," and proceeds to ignore almost entirely all the incidents occurring during the years intervening between September, 1837, and May 1st, 1844, simply remarking: "Vail began his new duties very promptly, as numerous letters between himself and Prof. Morse testify." These comments are made upon an article that appeared in the *Electrical Engineer* of May 23, 1894, and are cited as an evidence of the truth of the statements just made.

A son of Prof. Morse has recently written to a journal, in attempted refutation of my claims for Alfred Vail, as follows: "My father's claims were upheld by the Supreme Court of the United States, and during his lifetime he successfully defended his title to the father of the telegraph against countless claimants who had contributed something or nothing to its success. That Alfred Vail rendered most valuable *technical* and *financial* assistance to Prof. Morse, those who know anything about the birth of the telegraph would never dream of denying." In the light of the fact that Joseph Henry had, early in the year 1831, successfully operated the first magnetic telegraph, obtaining signals by striking a bell with an armature, it seems somewhat ludicrous to read the son of Morse stating: "The first simple principles which sprang as if by *inspiration*" (?) (suggested to him by Dr. Jackson, of Boston, a fellow passenger) "into the brain of the poor artist in the packet ship *Sully* in 1832 are the principles of the telegraph of to-day." The son and others who champion Morse's cause and claims to the right of being considered the only one entitled to the credit of being the *inventor* of the telegraph, in their zeal overlook the basis of the claims that are made for Joseph Henry and Alfred Vail, and with a lofty manner, indicating refusal to believe or credit anything that may question the position of their idol, cast the subject aside, advancing no evidence, no facts to controvert the statements made in opposition.

The so-called Morse telegraph of this day and since 1844 consists, as all familiar with it know, of a battery to generate electricity (which Morse did not invent), of a wire (which Morse did not invent), of a sounding key (which Alfred Vail did invent), of a recording receiver (invented by Alfred Vail, and which is a combination of the electro-magnet of Joseph Henry, and an embossing device or sounder entirely of Mr. Vail's invention, as his assertion printed here will attest), and the dot and dash alphabet (which, as we have shown, was invented by Alfred Vail).

It will be difficult to find anything, therefore, in the so-called "Morse" telegraph as it is, and as it has been ever since 1844, that Prof. Morse could claim as his "invention" excepting through the fact of an agreement with Alfred Vail by which the latter was required to consider his own inventions as but a part of the patent taken out solely in the name of S. F. B. Morse.

To be continued.

Reported Pullman-General Electric Deal.

It was stated in a somewhat positive manner by the Boston *Herald* last week that the Pullman Company were about to purchase the T.-H. factories at Lynn and remove their entire business from the town of Pullman. The works cost $2,000,000 and could now be bought for one quarter of that sum. The report does not seem credible, however. An important feature of the Pullman business is the land scheme. The company by moving would lose a very large amount, probably running into the millions, from depreciation in the value of property at Pullman.

A Literary Group.

Public Opinion, without which no busy man's complement of weekly literature is complete, has issued Group No. V of the series of Albertype reproductions, comprising the photographs of fifty prominent contributors to magazine literature of the day. This is one of the most interesting of the whole series, and will be a fitting ornament for the walls of any office or library.

Resonance Analysis of Alternating and Polyphase Currents.—II.

BY M. I. PUPIN, PH. D.[*]

IV.—LOCATION OF THE ORIGIN OF UPPER HARMONICS.

A. *Experiments With Alternator of Smooth Core Armature.*

1st Series.—The first set of experiments in this direction was performed with the 10 H. P. Fort Wayne 8 pole alternator with smooth core armature and the Stanley 5 K. W. transformer (closed magnetic circuit). The secondary circuit was open and a Cardew voltmeter indicated the secondary voltage. The current which excited the field of the alternator was gradually increased. The secondary voltage measured the strength of this excitation. The air-core transformer with the resonator was inserted into the primary circuit as indicated in Fig. 1*b*. The resonant rise of potential, recorded by the multicellular voltmeter *e'*, was carefully determined at every excitation for the fundamental frequency and the first odd harmonic. Higher harmonics were present, but very faint. The results are given in Table IV and plotted in Fig. 5. The initial voltage in the resonant circuit was small, just perceptible in the multicellular voltmeter.

TABLE IV.

Secondary Voltage.	Resonant Rise in Volts Due to the Fundamental.	Resonant Rise in Volts Due to the First Odd Harmonic.
43	122	58
48	130	65
53.5	136	72
56	138	73
62	146	80.5
66 75	152	86
75	160	94
83	170	104
88	175	110
97	185	117
104	195	128.5

The curves in Fig. 5 were plotted from this table by taking the readings of the first column for the abscissæ and the corresponding readings of the second and third columns for ordinates. The upper curve corresponds to the fundamental and the lower curve to the harmonic. The two curves are two straight lines parallel to each other, which means that the fundamental and the harmonic increase at the same rate from nearly one-third excitation to full excitation of the alternator. This result I did not expect, but its correctness was verified beyond all reasonable doubt.

The same series of experiments was extended to lower excitation of the alternator, but, since I had no low reading alternating current voltmeter, the excitation was measured by measuring the exciting field current. This current was ten amperes at full excitation and the series of experiments extended down to 1.5 amperes, hence to nearly one-seventh of the full excitation. To bring the readings of the resonant rises of potential within the scale of the multicellular voltmeter at low excitations the number of turns in the air-core transformer was suitably increased. Within all these limits of excitation both the fundamental and the harmonic increased at the same rate and proportionally to the excitation. This curious relation I mistrusted at first and suspected the existence of something like sympathetic resonance mentioned above. But all experimental evidence is in favor of its correctness.

2d Series.—To determine whether the presence of the harmonic was due to the action of the transformer or to that of the alternator, the transformer was disconnected, and two series of incandescent lamps, connected in parallel, were substituted in its place. Each series consisted of thirteen lamps, each about 24 C. P. The resonator, with its air-core transformer, remained in circuit as before. First one series of lamps was placed in circuit. The rise due to the fundamental was stronger than in the preceding experiments, but that due to the harmonic was exceedingly faint. When both series of lamps were thrown in, the harmonic appeared a trifle stronger, but still very weak. Hence the inference that the harmonic was due almost exclusively to the action of the transformer.

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[*] A Paper presented at the Eleventh General Meeting of the American Institute of Electrical Engineers, Philadelphia, May 18, 1894.

It should be observed here that the alternator armature, though well laminated, runs fairly hot in a short time, hence it must be the seat of a decidedly strong hysteretic process. On the other hand, the transformer does not heat nearly as much as the alternator armature, and yet its action produces the harmonic. This certainly seems to speak strongly against the view that harmonics are due to hysteresis. Other evidences against this view will be given below.

3d Series.—A series of experiments with open magnetic circuit transformers of induction coil type in place of the lamps showed the harmonic much stronger than the lamps did, but weaker than the experiments with the transformer of closed magnetic circuit. Although I have not succeeded in obtaining accurate numerical comparisons between the two types of transformers in this respect, one thing is certain, and that is, closed magnetic circuit transformers distort under similar conditions the primary current considerably more than transformers with open magnetic circuits; on the other hand, in the first case the distortion is confined almost entirely to the primary circuit, when the secondary is closed by a non-self-inductive resistance, whereas in the second case it is felt in the secondary circuit also, though considerably less than in the primary.

The general conclusion of this group of experiments may be summed up as follows:

1. A ferric self-inductance in circuit with an alternator which gives a simple harmonic electromotive force distorts the current by introducing higher odd harmonics, principally the harmonic of three times the frequency of the fundamental.

2. This harmonic (and in all probability all other harmonics) increases at the same rate as the fundamental when the excitation increases, the rate of increase being up to 4,000 C. G. S. lines of force per square cm. proportional to the intensity of magnetic induction in the core of the ferric inductance.

3. When this ferric induction is a transformer then the distortion appears, but not seriously, in the induced secondary electromotive force if the transformer has an open magnetic circuit, it does not appear there to any extent worth considering if the magnetic circuit is a closed one.

4. A practically simple harmonic electromotive force is produced by alternators with smooth core armatures, even if the machine is worked at considerable degrees of magnetization of the armature core.

B. *Experiments With Alternator or Slotted Core Armature Type.*

The machine employed in these experiments was the 1 H. P. alternator mentioned above. It is a 16 pole machine; its armature is a Crocker-Wheeler 1 H. P. motor armature wound for 500 volts. It gives at full excitation, the speed at which I usually ran it in these experiments, about 1,500 volts.[1] The transformer connected with it was of induction coil type with a cylindrical iron core made up of very carefully insulated thin iron wire. The same series of experiments were performed as under group A. The first series in this group gave exactly the same results as the corresponding series in group A. The excitation varied from one-seventh of the full to the full excitation; the amplitude of the fundamental and the first odd harmonic[1] varied at the same rate during the whole interval, so that a parallel pair of straight lines like those in Fig. 5 could be plotted in this case also. The second series resulted in the conclusion that the harmonic was very strong and due in a very large measure to the action of the armature and not to that of the transformer as in the other case, although the transformer also contributed a distinct but small measure to the strength of the harmonic. The third series showed that the harmonic appears in the secondary of an open magnetic circuit transformer, although considerably weaker, but does not appear there to any appreciable extent when the magnetic circuit is a closed one.

To the four conclusions given at the end of the series of experiments under group A we may, therefore, add the following additional conclusions:

5. An alternator with slotted core armature produces a complex electromotive force in which the upper harmonic of three times the frequency of the fundamental is generally by far the strongest.

6. The amplitudes of the fundamental and the harmonic increase at the same rate with the increase of excitation; this rate is proportional to the excitation, that is to say, proportional to the magnetization of the armature.

7. A ferric inductance in circuit with a slotted iron core armature introduces no new harmonics. It seems to strengthen those already existing in the electromotive force, that is, odd harmonics, especially the first odd harmonic.

The same conclusions will evidently hold true for alternators of ordinary types, that is, alternators whose armature is made up of coils wound on iron cores which are bolted to a cylindrical iron drum common to all of them.

V. EFFECT OF THE LOAD UPON THE HARMONICS.

It is a well-known fact that the distortion of the primary current disappears gradually with the increase of the secondary load, that is, when the external part of the secondary circuit is a non-self-inductive resistance. The question arises now, what becomes of the harmonics which produce the distortion in the primary when the secondary current increases? The following experiments seem to answer this question definitely.

The arrangement of circuits was that given in Fig. 1*b*. The secondary circuit of the large 5 K. W. transformer contained an electrolyte resistance and the secondary current was measured by means of a Siemens electro-dynamometer. For every particular value of the secondary current the resonant rises of potential due to the harmonic and the fundamental were carefully determined by means of the multicellular voltmeter. Table V contains the observations relating to the harmonic of three times the frequency of the fundamental; Table VI relates to the fundamental (130 P. P. S.). The apparatus employed were the large alternator and the 5 K. W. transformer.

Table VI requires explanation. When the secondary current was over 3.6 amperes the resonant rise of the fundamental was too high for the voltmeter employed and also too risky for the condenser. An auxiliary resistance had to be introduced into the resonator to bring the resonant rise down to the limits of the voltmeter. These auxiliary resistances are given in the third column. The readings that would have been obtained without these auxiliary resistances were then calculated, roughly, as follows: According to theory, which was verified by experiments described in the beginning of this paper, the resonant rise multiplied by the resistance of the resonator gives a constant product for all resistances as long as the period of the resonator is practically independent of these resistances. The resistance of the resonator coils was 16 ohms. Hence if, for instance, x denote the rise which would have been obtained without auxiliary resistance in the resonator when the secondary current was 5 amperes, then since with an auxiliary resistance of 50 ohms the resonant rise was 122 volts we have with a rough approximation

$$x = \frac{122 \times 66}{16} = 503 \text{ volts.}$$

In this manner the figures of the fourth column were obtained. They are only very rough approximations, but still they give a very fair idea of the ratio of the fundamental to the upper harmonic at various loads. Curves I and II, Fig. 6, were plotted from these data. The secondary amperes were taken for the abscissæ and the corresponding resonant rises in volts for the ordinates. Curve III represents Curve II plotted on a different scale for the volts of the resonant rise of potential. These are given in the right hand vertical column of the diagram. This curve gives a better picture of the gradual apparent increase of the harmonic. An inspection of I and II shows clearly how much more rapidly the fundamental increases than the harmonic. In reality the increase is even more rapid, for according to Table V it appears as if the strength of the harmonic increased with the secondary current, only much less rapidly than the fundamental. For instance, at open secondary the voltmeter indicated 65 volts for the resonant rise of the fundamental, and at 56 amperes in the secondary this rise was indicated by 202 volts. But it must be noted that in the first case the voltmeter needle went from practically zero at no resonance to 62 when resonance was reached, whereas in the second case it went from 135 volts at no resonance to 202 volts when resonance was reached, so that the real resonant rise was practically the same in both cases. Similarly for all other loads in the secondary. It follows, therefore, that if the harmonic increased at all with the increase of the load, this increase was much smaller than appears at first sight from the data of Table V. The more important conclusion, however, which follows from this experiment and which I wish to point out more particularly is, that the harmonic which manifests itself in the distortion of the primary current when there is no load in the secondary is present at all loads, if not stronger, then certainly with

TABLE V.

Secondary Current in Amperes.	Resonant Rise of the Harmonic in Volts.
0	65
3.6	65
4.8	66
6.9	68
8.5	70
11.5	76
15.7	85
20	97
28	120
40	162.5
56	202

TABLE VI.

Secondary Current in Amperes.	Resonant Rise of the Fundamental in Volts (observed).	Auxiliary Resistance in the Resonator in Ohms.	Resonant Rise of the Fundamental in Volts. (calculated).
0	80	0	80
3.6	240	0	240
5.0	122	50	503
6.7	150	50	616
9.0	200	50	825
17.3	200	100	1,450
27.0	185	210	2,613
44.0	155	410	4,127
56.0	160	510	5,100

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[1] A more complete description of this machine and the transformer will be found in *Amer. Jour. of Science*, June, 1893, p. 510, etc. Owing to the accident which somewhat impaired the insulation of the armature the machine was run last year at low excitation, and hence low voltage, although the speed was then considerably higher.

[1] The second odd harmonic, that is, the harmonic whose frequency is five times that of the fundamental, was there but weak.

about the same strength. At full load this harmonic could not possibly be detected by Joubert's method of sliding contact, it is so exceedingly small in comparison to the fundamental.

This persistence of harmonics at all loads even when completely hidden by the fundamental wave holds true also when their origin can be traced to the action of the armature of the generator, as in the case of the machine with slotted iron core armature. In all cases their strength seems to depend upon the mean intensity of magnetization of the magnetic circuits to which they owe their origin and upon nothing else.

Another somewhat more difficult but very instructive way of proving the persistence of the harmonics is represented in Fig. 7. In circuit with the primary of the large machine and transformer described above are two equal air-core transformers, *a b* and *a′ b′*. By means of a double switch either one of the two can be made a part of the resonating circuit, *c, d, f*. A number of condensers, D, in series, are connected across primary circuit as indicated. The two air-core transformers, *a b* and *a′ b′*, will be equivalent when the resonator voltmeter, *e*, gives the same indications, no matter which one of the two transformers be connected to the resonator. This balanced arrangement having been obtained, the balance will be disturbed as soon as the condenser D is plugged in, and it will be disturbed in a great variety of ways, according to the capacity plugged in. But when the transformer B is of closed magnetic circuit type, then the resonator indications remain practically the same as long as the resonator is switched on the air-core transformer *a′ b′*, no matter what capacity is plugged in the condenser D. When the resonator is switched on the air-core transformer *a b*, then its indications will be different for every particular capacity in D. In fact the circuit A, *a b*, D, A can be treated as an entirely separate circuit from the circuit A, *a′ b′*, B, A.

This statement needs practically no modification in order to cover that case also in which the self-inductance of the primary of B is diminished by putting a non-self-inductive load on the secondary. This utter disagreement between theory and experiment deserves a closer discussion, but since its connection with the subject of this paper is only an indirect one, I prefer to reserve it for some other time. That which has a direct bearing upon the present discussion is the method which the above mentioned relation offers for observing the variation of the harmonics with the load without the disturbing inductive effect of the large primary current. It is this: Connect the air-core transformer *a b* (and with it the resonator) in series with the condenser. Add to this series an auxiliary coil *c* (no iron core). By the combination thus obtained bridge the primary circuit, so that in place of the simple condenser bridge D given in Fig. 7 there will be a bridge consisting of condenser D, the air-core transformer *a b* and the auxiliary coil *c*. The office of the auxiliary coil will be explained presently. The secondary C being open, tune the circuit consisting of the alternator armature, the primary conductors up to the bridge and the bridge to any one of the harmonics. The tuning is done by means of varying the capacity of the condenser and the self-inductance of the auxiliary coil. Then close the circuit by means of an electrolyte resistance and vary the secondary current. It will be found that the harmonic diminishes only slightly with the increase of the secondary load. As an example I give the following: The circuit just mentioned was tuned to the harmonic of five times the frequency of the fundamental, that is, 650 P. P. S. At no load the resonator indicated a rise of 108 volts, at full load the rise was 94 volts. But this drop, small as it was, might have been caused by armature reaction.

Whatever the ultimate meaning of the appearance and the persistence of the odd harmonics in an alternating current wave may be I am not quite prepared to state with any high degree of confidence. One thing is certain, and that is that they are present at all loads with almost undiminished strength. Their presence is hidden by the fundamental wave at heavy loads, but when conditions favoring resonance with any one of them arise they will certainly come out and do all the mischief they can to the insulation. The self-induction of a motor, or that of a closed magnetic circuit transformer, has practically no bearing upon the conditions of their resonance. These conditions depend in such circuits solely upon the self-induction of the alternator on the one hand and the self-induction and static capacity of the line on the other. According to the experiments just described the resonant current is confined entirely to the alternator and the line, the dielectric forming a part of its circuit. These observations will be modified in the case of transformers with open magnetic circuits, and their equivalents, that is, closed magnetic circuits possessing considerable magnetic leakage, especially when the conditions of the line favor resonance with the fundamental frequency, this frequency being low; such magnetic circuits possess much less magnetic sluggishness and can influence considerably the conditions of resonance with a low frequency.

VI.—DISTORTION OF THE SECONDARY CURRENT.

It was pointed out that the superposition of harmonics upon the fundamental wave was confined to the primary circuit when the secondary is closed by a non-self-inductive resistance, that is, if the transformer is of closed magnetic circuit type. With an open magnetic circuit transformer the deviation of the primary current wave from the simple harmonic form, due to action of the generator or the transformer, or both, is felt more or less in the secondary current also. If, however, the secondary is closed by a a ferric self-inductance, then odd harmonics will appear in this circuit also in both types of transformers. In fact, the secondary circuit should now, as far as the harmonics are concerned, be considered as a separate circuit, in which the secondary coil of the transformer and the ferric inductance in the secondary circuit play the same part as the armature of the alternator and the transformer play in the primary circuit.

The series of experiments which related to the origin and growth of harmonics in the secondary circuit was exactly the same as the one described above, by means of which the so-called distortion of the primary current was studied. The results were the same. The presence of harmonics is due to the action of the ferric inductance; their strength increases proportionally to the intensity of magnetization of the iron in the ferric inductance. They seem to be entirely independent of hysteresis, that is, if by hysteresis the process be understood by means of which most of the heat is generated in a very finely laminated, well insulated and well annealed iron core, when such a core is subjected to rapid reversals of magnetism. I shall describe briefly an experiment bearing upon this point. The secondary circuit of the 5 K. W. transformer was closed by an electrolyte resistance, and a short cylindrical coil having about 120 turns coarse copper wire. A short cylindrical core made up of very fine (No. 26 B. and S.) and well annealed iron wire could be inserted into this coil. The core was 40 cm. high and 5 cm. in diameter. The wires were fairly well insulated from each other. A layer of fine copper wire surrounding this coil formed part of the resonator circuit. First, the secondary current was passed through the coil before the iron core was inserted. The resonator could detect no harmonic worth mentioning even when the current was increased almost to full load. But as soon as the iron core was introduced the odd harmonics appeared, especially the third harmonic; its strength increased proportionally to the current. Placing now another similar iron core on the top of the first and adjusting it in such a way that it allowed a small rocking motion the two cores could be set into violent vibration by the inductive action of the current, which gave a very loud note corresponding in pitch to the frequency of the alternator. The vibration could be stopped by pressing the top core against the lower core and against the table. The vibration produced no appreciable difference in the strength of the harmonic; if anything, it seemed to make it stronger. This experiment seems to me to render the theory which ascribes the origin of harmonics to the hysteretic action of iron completely untenable.

I do not think that the proper time has arrived yet for the formulation of a physical theory which will give a complete account of the peculiar behavior of iron, by means of which it superposes odd harmonics upon the wave of a simple harmonic current. The view which irresistibly suggests itself to my mind is simply this: Upper harmonics will be generated whenever more or less abrupt changes of the magnetic state in any part of the magnetic field through which an alternating current flows occur. A slotted core armature or an armature made up of coils with iron cores distributed over a drum common to all of them will introduce such abrupt changes. An alternating current motor, especially when it is not of a smooth core armature type, will also cause abrupt changes of magnetism and hence cause strong deviations of the feeding current from the simple harmonic form. But if this view be correct, then every complete cycle of magnetization to which iron is subjected when under the inductive action of a simple harmonic current must be accompanied by some abrupt changes in magnetism, and that, too, whether the mean magnetic intensity of the cycle be large or small. A great many things may be suggested which could account for such cyclic abrupt changes. One thing is certain and that is, that hysteresis, as commonly understood, will not account for them; for these peculiar abrupt cyclic changes, if they really exist and are the cause of harmonics, are not affected by mechanical vibrations by which, as is well known, all hysteretic effects are influenced very much. But whatever the real theory underlying these upper harmonics may be, the bare fact which the engineers have to face is: there is no cure against harmonics as long as the circuits contain iron. Hence construct your lines in such a way that conditions favoring resonance with the frequency of the fundamental or with one of its odd upper harmonics will seldom occur, and whenever they do occur the resonant rise of potential should not be capable of producing any damage. Avoid slotted armatures and armatures with projecting pole pieces, and keep the magnetization down as much as possible.

VII.—FLUCTUATIONS OF THE ROTARY FIELD.

Before closing this paper I will describe briefly the application of the resonance method of analysis to the study of the intensity fluctuations of a rotary magnetic field. The investigation was carried out by two students of the Electrical Department of Columbia College, at my suggestion, and will be published in the near future. The method, briefly stated, is this: A suitable number of turns of wire are subjected to the induction of a rotary magnetic field. These turns form part of a resonator. Whatever fluctuations there be in intensity of the rotary field they will be periodic, their period bearing a perfectly definite ratio to the periodicity of the current which produces the rotary field. For instance, in a three-phase combination of alternating currents the intensity of the rotary field will, according to theory, show six maxima and six minima during each complete revolution, the maxima differing from the minima by about 14 per cent. A circuit, subjected to the inductive action of such a field should have a periodic electromotive force induced in it whose frequency will be either three or six times the frequency of the fundamental according to the shape of the curve of fluctuations. Similarly in a rotary magnetic field produced by a two phase combination of alternating currents. If such electromotive forces were induced the resonator would detect them, and from the resonant rise of potential the extent of the fluctuations producing these electromotive forces could be estimated. No electromotive forces of this type were detected in either a triphase or a two phase combination. Hence the inference: Rotary magnetic fields produced by reasonably well constructed machines are not accompanied by fluctuations in their intensity.

In conclusion I wish to thank my friend, Prof. H. A. Storrs, of the University of Vermont, who during his whole stay at my laboratory this year was always anxious to aid me in my work in a most ready and disinterested way. His most efficient assistance was of the greatest value to me.

Recollections of Werner Von Siemens.[*]

X.—Scientific Writings.[*]

I have in these reminiscences frequently had occasion to make some explanatory observations on my technical papers, which are described in the second volume of my "Scientific and Technical Papers," published in the years of 1889 and 1891 by Julius Springer.[†] I have called attention to most of my earliest scientific writings, as they have had great influence on my career, and as they have probably remained unknown to the younger generation of physicists. I feel, however, the need of making also some critical remarks, accompanied by an estimate of results, on my later scientific work, which in many points diverges from the accustomed paths of the prevalent physical theories and has, therefore, found no general recognition.

In several papers written in the years 1860 to 1866, and published in *Poggendorff's Annalen*, I investigated the question of the electric conductivity of metals, and proposed the first and up till now only method of obtaining an empirical reproducible standard of resistance. I showed that my method made it possible to determine exactly the resistance of an approximately prismatic space filled with pure mercury to within a ten thousandth of its value, and thus solved the question of an absolute unit of resistance, i. e., one resting on a definition, with an exactness corresponding to the fineness of our measuring instruments. By these means exact and comparable electric measurements were first rendered possible.

In the course of this investigation I confirmed the proposition, already laid down by others, that solid alloys always exhibit a greater resistance than corresponds to the resistances of the several component metals; I showed, however, that this does not hold good for fluid metallic combinations, which retain in the fluid state the resistance of the single metals unchanged. This behavior of the metals I showed could be utilized for the determination of the specific resistance in the fluid state of metals not readily fusible. Further I discovered that the resistance of metals is considerably enhanced by fusion, and that at the same time the latent heat of fusion increases the resistance in a higher degree than the sensible heat of a solid or liquid conductor. I found, too, that the increase of resistance by fusion does not occur discontinuously, but that the resistance rises continuously within a certain range of temperature and joins without break the resistance curve of the fused metal. Hence I concluded that the physical process of fusion and solidification essentially consist in the absorption and liberation of latent heat, which take place within a definite range of temperature during liquefaction.

In a later essay on the dependence of the electric conductivity of carbon on temperature I have confirmed Matthiessen's assertion, that the conductivity of carbon increases with rising temperature, and have shown the objections of Beetz and Auerbach to be erroneous. In explanation of this surprising behavior of carbon I advanced the hypothesis that the different states of carbon—charcoal, graphite, diamond—are allotropic states of "carbon devoid of latent heat" not occurring in nature, and are essentially distinguished from one another by the quantity of absorbed latent heat.

This hypothesis was further confirmed and developed by an investigation of the property of selenium, discovered by Willoughby Smith, of being a better conductor of electricity in the light than in the dark. I found that besides the selenium, which is changed by a slight enhancement of temperature from the amorphous non-conducting into the crystalline conducting condition, there is still a third modification which is produced by heating amorphous selenium a long time till near its melting point, i.e. to about 400 degs. F. Both these modifications of the electricity conducting selenium are essentially distinguished from one another by this, that the former conducts electrolytically, i. e. like the electrolytic fluid conductors, better at a higher temperature, the second, long and highly heated, on the other hand metallically, i. e. like the metals, worse at a higher temperature. In this behavior of amorphous selenium, rapidly cooled from the fused condition—viz., when heated to over 180 degs. F. of losing indeed a great part of its latent heat of fusion, retained in rapid solidification, and of becoming electrolytically conductive, but with longer continued and higher heating in the vicinity of its melting point, of giving off more latent heat, and then of becoming still better conductive and that metallically--I found a confirmation of my previously suggested hypothesis, that the electrical resistance of a body is an equivalent for the quantity of heat stored up in it in the sensible as well as in the latent state. Further it seemed to prove that latent heat has a greater power than sensible heat of causing resistance, and that bodies without allotropically latent heat conduct metallically, and moreover in such a way that the resistance increases uniformly with the temperature reckoning from zero, while the resistance-causing influence of allotropically latent heat decreases with rising temperature.

According to this theory all simple bodies, which are not an allotropic modification of their original metallic primitive state, in which heat has become latent, must conduct metallically, and it is probable that the so-called active state of bodies is nothing else than this state devoid of latent heat, termed by me the metallic, which in semi and non-metals can only occur in chemical combinations without passing immediately into an allotropic modification, heat becoming latent. According to this hypothesis we have, therefore, to imagine that the molecules of all non-metallic solid bodies can assume different positions of stability, corresponding to definite quantities of work which have been used up for constituting them. Only metallically constituted bodies can enter into chemical combinations. Latent heat, therefore, forms an obstacle to chemical combination, and if such nevertheless occurs heat must at the same time become sensible. Conversely a body becoming chemically free must be constituted metallically, is therefore in the active state at the moment of becoming free. Left to itself, heat becomes latent by absorption of sensible heat if it is a semi or non-metal whereby its electric conductivity is then partially or wholly destroyed. Heightened temperature makes the molecular arrangement, which corresponds to the heat absorbed, less stable, enhances therefore the electrical conductivity and at the same time the chemical affinity. Since heat becomes latent when metals form alloys, the conductive resistance of such alloys does not increase in proportion to the absolute temperature, as with the simple pure metals, but the latent heat of combination of the alloy forms a disturbing element, which further increases the resistance and thereby nullifies the proportionality of the same to the absolute temperature.

I succeeded in employing also technically the metallically conductive modification II of crystalline selenium, discovered by me, for the construction of a selenium photometer.

In an old paper I furnished the proof that the dielectric becomes heated by repeated charge and discharge, and thereby found an experimental confirmation of Faraday's molecular induction theory.

In the year 1875 an opportunity occurred of bringing into use my modified method, proposed in 1845, of measuring the velocity of propagation of electricity in suspended wires. The experiments, which were instituted with a double iron wire 7·87 miles long, yielded a velocity of propagation of 150,300 miles, a result which satisfactorily agrees with Kirchhoff's calculated result, regard being had to retardation by the condenser action of the wires and to the self-induction. Before the performance of these experiments, very carefully carried out by Dr. Frolich, I inclined to the opinion that the actual velocity of electricity in conductors would be immeasurably large, as an experiment, which I made with a caoutchouc tube more than a hundred feet long filled with water, did not show any perceptible difference in position of the spark marks. The velocity of propagation of electricity could accordingly not depend mainly on the specific resistance of the traversed conductor, and I regarded it therefore as probable that the very different values found by Wheatstone, Fizeau, Gounelle, and others had only been expressions for the retardation by the charge of the conductors employed. This doubt was removed by the experiments described, for the further prosecution of which I have unfortunately never found time and opportunity.

I was led into a sphere of inquiry entirely new for me by an observation of the activity of Vesuvius in May, 1878. It struck me that from the brightly glowing opening at the apex of the lava cone, which had risen in the interior of the large dark crater, explosion-like eruptions occurred with great regularity at intervals of several seconds. More exact observation showed that each explosion was followed by an absorption of air so powerful that the opening often sucked in at the same time even ejected scoriæ or stones, which were again precipitated in its vicinity. Inflammable gases, evolved continually from the earth's interior, must have become mixed in the upper vent of the crater with atmospheric air, which had been absorbed by the rareaction of the air caused by the preceding explosion, and thereupon exploded, to produce anew a rarefied space. This observation led me to a consideration of the process of the formation of the earth and its present condition from a physicomechanical standpoint, the results of which differed considerably from the prevailing opinions.

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[*] Selected from "Personal Recollections of Werner Von Siemens," recently published in America by D. Appleton & Company, New York, 416 pp., 12mo, uncut edges, wide margin, photogravure portrait.

[†] English edition published by John Murray.

Two diametrically opposed views have hitherto been advanced in geology, that of the pure geologists and that of the mathematicians. The former mostly adhere to the old view, already to be called historical, that the earth was once in a molten state, whilst air and water formed the likewise still glowing atmosphere, that then with progressive refrigeration and after formation of a solid crust the seas were disengaged, and with the help of frequent partial elevations and depressions of the crust deposited the vast sedimentary strata which now cover almost the whole surface. These elevations and depressions were said to be produced by internal volcanic forces, which still to this day give evidence of themselves in volcanoes. English physicists, among them Sir William Thomson, now Lord Kelvin, have opposed this basis of the theory of the earth's formation with weighty arguments. Lord Kelvin has declared that the whole terrestrial body must be more solid than glass hard steel, as calculation proves that its surface would otherwise participate in the tidal movement produced by the attraction of sun and moon, consequently an independent ocean-tide could not then occur. J. Thomson has supported this calculation by a physical consideration which goes to show that the fusing temperature of bodies which expand on solidification is lowered by pressure, but of bodies which contract on solidification is heightened by pressure. Now, since the silicates, as he infers, contract on solidification about twenty per cent., the pressure increasing with the depth would not allow the rock masses to fuse in spite of the heightened temperature, but make them still more solid.

It is remarkable that these diametrically opposed views on the nature of the earth's crust should have been before the world for years without giving rise to violent controversies, although the question at issue affects the very basis of practical geology. The geologists, as already mentioned, for the most part maintain the theory of a crust floating on a fluid or gaseous nucleus, and the mathematicians cling to Lord Kelvin's theory of a solid nucleus, without troubling themselves much about the difficulties in the way of explaining the actual formation of the surface!

I have tried to solve this contraction by showing that considerations having reference to actual facts opposed the physical foundations of Thomson's calculations. The chief of these is that Bischof's statement, that silicates became about 20 per cent heavier in passing from the fluid to the solid state, is incorrect—as follows at once from the well-known fact that solid silicates always float on the fused ones when they have nearly assumed the temperature of the latter. Further I called attention to the point that Lord Kelvin's calculation takes no notice of the time required by the viscous terrestrial mass to assume the form which is every moment prescribed to it by the deforming tendencies of the attraction of the sun and moon. As in these changes of form we have to do with dislocations of masses, which stretch continuously over the whole body of the earth from molecule to molecule, and therefore require a considerable time to take place, no universal tidal wave could be produced advancing uniformly with the earth's rotation, and altogether such a one could only arise to a very slight degree. A refutation of these objections to the mathematical necessity of a solid core is still wanting, and we are therefore entitled, in discussing the formation of the earth's surface, to assume a viscous or gaseous state of the interior.

BOOK REVIEW.

THE PRACTICAL APPLICATION OF DYNAMO-ELECTRIC MACHINERY. BY C. W. MCFADDEN AND WM. D. RAY. 12mo. 167 pages. Illustrated. Price, $1.00. Chicago: Date & Ruggles.

This is a handy little volume suitable for the coat pocket, and one for which there is certainly room. It is a clear and concise exposition of the theory and construction of dynamo-electric machinery without undue use of technical terms, and just such a book as the layman anxious to know something about the subject needs. The scope of the work is best indicated by the table of contents, which is as follows: Chap. I, Elementary Data, Units of Measurement, Ohm's Law. Chap. II, Magnetism and Induction, Methods of Current Generation. Chap. III, Theory of Dynamos, Action of Commutators, Methods of Dynamo Control. Chap. IV, Current Distribution, Losses in Copper Conductors, Fuses and Safety Cut-Outs. Chap. V, Transformers, Construction and Use, Alternating Current Distribution. Chap. VI, Types of Dynamos, Direct and Alternating Current, Their Application in Practice. Chap. VII, Causes of Trouble in Dynamos, Their Remedy and Prevention, Methods of Testing for Faults.

The Canadian Electrical Association.

The next Convention of this Association will be held in Montreal the latter part of September. The date of the Convention will if possible be arranged to suit the usual fall excursions given by the railroad companies to Montreal and Quebec, so that extremely favorable rates may be expected.

The Convention will be held in the Mechanics' Institute Building, and will extend over three days. The papers that will be brought before the Convention and the discussions thereon will be of the utmost interest to all branches of the profession. They comprise:

"The Possibility of Securing Better Regulation at Central Light and Power Stations by means of Fly Wheel Accumulators of Improved Construction," by Mr. John Galt, C. E. and M. E., Toronto.

"A Method of Distribution with Equalization of Potential Difference," by Mr. D. H. Keeley, of the Government Telegraph Service, Ottawa.

Paper by Mr. E. C. Breithaupt, Berlin, Ont.

"The Application of Electricity for Medical and Kindred Purposes from Light and Power Circuits," by Mr. W. B. Shaw, Montreal.

Paper by Mr. T. R. Rosebrugh, School of Practical Science, Toronto.

"Electrolysis," by Mr. J. A. Baylis, Bell Telephone Company, Toronto.

"Telephone Cables, their Construction and Maintenance," by Mr. J. F. Schwartz, Bell Telephone Company, Montreal.

"Alternating Motors," by Mr. L. M. Pinolet, Montreal.

Paper by Mr. John Langton, Toronto.

The Falkenau Engineering Co., Limited.

The above is the corporate title of a new engineering firm just organized in Philadelphia. The members are: Arthur Falkenau, M. E.; Edwin R. Keller, B. S., M. E.; Clayton M. Pike, B. S.; Elmer G. Willyoung, B. S. These gentlemen have all had extended experience in the business, and they should be successful in their new undertaking. Their offices are in the Betz Building, Philadelphia.

COMMUNICATIONS.

The General Electric Company's Chilean Affairs.

Editor of ELECTRICITY.

DEAR SIR: I beg to be allowed to make use of your valued columns to correct some misstatements of Mr. H. C. Stevenson, of Concepcion, in an article which appeared in your issue of April 4, entitled "General Electric Business Methods," which do great injustice to the General Electric Company as well as to Mr. Mazenet and myself.

The General Electric Company have never offered Mr. Stevenson, through me, to send him machinery for increasing his plant and receive in payment mortgage bonds on his establishment. Mr. Stevenson has evidently misconstrued my statement to him that if he would furnish me with an exact statement of his business, and would issue mortgage bonds, I would send them on to see if they could be placed in New York for such an amount as would pay for the machinery which he requires. As to Mr. Stevenson's statement that he holds the original letters in which the offer he speaks of was made, it is my belief that he will have a great deal of trouble to produce them, for the General Electric Company have furnished me with copies of all the letters they have written him, and I therefore believe that I speak with a full knowledge of the subject.

To close, I would add that over a year ago Mr. Stevenson sent orders to the General Electric Company, through me, for materials to the value of $18,261.07, in three installments, to be paid for on their arrival at Talcahuano. The goods arrived many months since and he has as yet not paid for any of them. His business methods are certainly more peculiar than those of the General Electric Company. Very truly yours,

GEO. W. WATERS,
Chile Agent of the General Electric Co.
Santiago, Chile, June 12, 1894.

"Electro-Dynamic Machinery."

OSTERVILLE, N. J., July 19, 1894.

Editor of ELECTRICITY.

A dispute has arisen among a few of us as to the correctness of the definition of "electro-dynamic machinery," as given in a contribution of Messrs. Houston and Kennelly to another paper in its issue of July 21st. The definition runs thus: "By electro-dynamic machinery is meant any apparatus for the production, transference, utilization or measurement of energy through the medium of electricity." Recognizing the scrupulous attention to accuracy in all things electrical for which your paper has become so distinguished, we have agreed to abide by your decision. T. T. J. AND OTHERS.

[Originally in machines of this type it was supposed that the fields must either be permanent steel magnets or electro-magnets excited from an external source. When it was discovered that a machine having electro-magnetic fields was capable of building itself up and could self-excite itself from the start—pull itself over the fence by its own bootstraps, as it were—the principle involved was called the "electro-dynamic principle," and machines constructed upon this self-exciting principle were termed electro-dynamic machines, and the use of this term was confined solely to such machines, whether series, shunt or compound wound. We think therefore that the definition above given is entirely too broad, and know of no authority for it, although the term as thus defined has come into general use through carelessness in the use of language, just as the term ampere is often used as a definite quantity instead of a rate. —ED.]

General News.

What is Going on in the Electrical World.

Duluth, Wis.—The city council has passed a franchise granting rights in Duluth to T. M. Zeller and others, organized as the Automatic Telephone Company.

Worcester, Mass.—The contract for the new electric plant for the Westboro Insane Hospital has been awarded to the Columbia Electric Company of this city.

Muncie, Ind.—Chas. H. McCulloch, of Boston, has been given a franchise of the streets of Red Key for the proposed electric railway between Red Key and Dunkirk.

Dedham, Mass.—Having tried the old-fashioned bell alarm for 258 years, Dedham has at last decided to discard it for an electric fire alarm system, which is being installed.

Salt Lake City.—The steam tramway used in transferring the ores from the Mammoth and Copperopolis mines to the Mammoth mill and the Union Pacific Railway is to be changed to an electric road.

Stroudsburg, Pa.—The Delaware Valley Electric Road will be built by the Union Electric Construction Company of Philadelphia. The work will be pushed in order to have the road completed by October.

Hastings, Neb.—The plant of the Hastings Electric Light Company has passed into the hands of a new company. A new power house will be built and the lines extended into the residence portion of the city.

Pittsburg, Pa.—The electrical display at the approaching Grand Army encampment will be a leading spectacular feature, and the committee are anxious to have it surpass anything hitherto witnessed on a similar occasion.

Saginaw, Mich.—Issac Bearanger, of East Tawas, has announced his intention of constructing an electric railroad from Saginaw to Bay City. The proposed road will touch Carrolltown, Zilwaukee, Frankenlust, Salzburg and West Bay City.

Buffalo, N. Y.—A company has been organized here to transform about 200 acres of land in the suburbs into a cemetery. They will put funeral cars on the electric railway passing the grounds, and thus do away with the expense of hearse and coaches.

Chicago.—The Co-operative Electric Light Company has made an assignment in favor of Jacob W. Richards as assignee. Judge Scales has entered an order for the assignee to operate the plant pending a settlement with the creditors. The assets of the concern are estimated at $200,000; liabilities, $100,000.

Erie, Pa.—The common council committee has approved an ordinance providing for the increase of the city indebtedness by $125,000 for the purpose of building and equipping an electric light plant, the question to be submitted to the citizens at the next general election.

Middletown, O.—The Cincinnati, Middletown and Dayton Traction Company have withdrawn their petition asking for the right of way through this city on account of the opposition of some members of the council. The road will not be abandoned, but will go through the outskirts of the city.

Johnstown, N. Y.—The question of a new railroad from Amsterdam to Gloversville is now claimed to be a matter of only a short time. It is stated authoritatively that a company was formed in this village last week in furtherance of the project and that enough money was pledged to build the road.

Detroit, Mich.—Contractor Thos. Nevins, of Orange, N. J., has closed the purchase of the Detroit street car lines. He will pay for the roads, which comprise eighty miles of tracks, thirty of which are already equipped with the trolley system, $8,250,000, $4,000,000 in cash and the balance in bonds.

Hudson, Mass.—The Electric Light Company has sued the town for $18,000 damages for its failure to purchase the electric lighting plant after having voted twice in open town meeting to accept the provisions of an act allowing towns to own and operate electric light and gas plants. The papers are returnable on August 1.

Richmond, Va.—At a meeting of the common council last week, Mr. Epps offered a resolution appropriating the sum of $100,000 for the building and equipping of an electric light plant to be owned by the city. The finance committee is to be furnished the money by the issuing of 4 per cent. city bonds or otherwise. The resolution was referred.

Columbus, Ohio.—The county commissioners have granted the right of way through this county to the Madison County line over the old National pike to a company organized to construct an electric line from this city to Cincinnati. The applicants were H. B. Morehead, L. D. Hagerty, Dennis Dwyer and O. B. Brown. It is a fifty-year franchise.

Baltimore, Md.—The Baltimore and Ohio Railroad Company is about to erect a power house designed to furnish the electric power for the operation of trains in the Belt Line tunnel. The power house is located at the southern end of the tunnel, and will be an imposing structure. —Work will begin on the Baltimore, Middle River and Sparrows Point electric road about August 15.

Binghamton, N. Y.—The bids for extending the electric light plant of the State Hospital, on being opened at a meeting of the board of trustees, were found to be $20,000 or more higher than the appropriation. The bids were all rejected and new specifications were ordered made. These specifications will omit the lighting of the farmhouse and buildings located far from the asylum.

McKeesport, Pa.—The *Herald* reporter has been taking a view of the new Westinghouse works at Brinton. He says: "One may get some idea of the magnitude of the new Westinghouse works by looking at the three immense buildings now under construction and then imagining five more gigantic structures covering more than as much ground as those already started. The whole plant when completed will occupy about fifty acres."

Rutherfordtown, N. C.—An electric railroad project of somewhat extensive scope is soon to be carried out in this vicinity. It provides for the building of a 17-mile road from Rutherfordton to Chimney Rock through the rich valley of the Broad River, between lofty mountains, with picturesque scenery on all sides. The building of an elevator to the top of Chimney Rock dome, a height of 1,164 feet, is also part of the project.

Lynn, Mass.—In the report of the assessors the statement is made that "the decrease in the value of General Electric stock, of which Lynn citizens are large holders, and the removal of a portion of the machinery to Schenectady, together with the reduction of manufacturing stocks in trade incident to the times, cause a loss of personal property of nearly $1,600,000. There is a gain of something over $1,000,000 in real estate, leaving a reduction of about half a million dollars in the total valuation."

Providence, R. I.—The Rice & Sargeant Steam Engine Company, recently incorporated for the manufacture of steam engines in this city, will make a specialty of a four-valve automatic cut-off engine with double parted rotary Corliss valves, provided with a trip gear and designed with particular reference to the needs of electrical and cable plants. The officers of the new company are: President, R. A. Robinson; vice-president, Z. Chaffee; secretary, John W. Sargeant; treasurer, Richard H. Rice.

Ottawa, Can.—Chas. R. Hosmer, of Montreal, Alex. Siemens, of London, Eng., vice-president of the Commercial Cable Company; Tobias Butler, of Montreal, and A. M. Neale, of Detroit, were here a few days ago to look over the ground with the colonial delegates as to building the Pacific cable. The capitalists of the party inspected the mica deposits in the neighborhood and the water power at the Chaudiere, with the possible view of locating electrical manufacturing works here.—The Electric Railway Company has placed incandescent lamps along their line from New Edinburgh to Rockliffe, the lamps being placed on every trolley pole.

Holyoke, Mass.—John P. Hurley, a resident electrician, has invented a new electric motor for running street cars. The principle, as explained by a local paper, "is to take the power from one rail and discharge it into the other. The power is supplied by means of an alternating dynamo, which feeds the converters, located in the automatic feed stations that are to be placed at intervals of 1,000 feet along the line. The motor is propelled on the magnetic principle, and cranks give the motion to the wheels as the driving bars are drawn backwards and forwards."

Pottsville, Pa.—The Car Equipment Company of Philadelphia has purchased a controlling interest of the Schuylkill Electric Railway of Pottsville, and it is their intention to extend the line about twenty-five miles in and around Pottsville, connecting St. Clair, Middleport, Tremont, Schuylkill Haven and other settlements contiguous to Pottsville. Jesse Newline and Robert Alliston have retired from the old board of directors, and W. A. Barritt, Jr., and Charles H. Barritt, president and treasurer respectively of the Car Equipment Company of Philadelphia, have been elected to fill these vacancies.

Brooklyn, N. Y.—The directors of the Boynton Bicycle Railroad propose to build a section of the road immediately. This section will start at the terminus of the Kings County Elevated road and run to Hempstead and Freeport, and also traverse the Rockaway peninsula. The board of directors of the new company, which proposes to revolutionize railroading on Long Island, is made up as follows: Gen. James Jourdan, president of the Kings County Elevated; Hon. Nicholas Stout, Jose F. Navarro, George W. Bergen, a director of the Brooklyn City Railroad; Benjamin Norton, president of the Atlantic Avenue Railroad; John M. Crane, president of the Shoe and Leather Bank; Hon. George M. Tileston, chairman of the board of supervisors of Suffolk County; C. Howard Schrimser, Oscar L. Schwencke, and Frank C. Sumner, treasurer of the Hartford Trust Company.

FOREIGN NOTES.

The French Thomson-Houston Company have declared a dividend for the year of 5 per cent. The company have decided to manufacture their electrical apparatus in France, and for this purpose new works are to be acquired by a consolidation. It has been resolved to increase the capital of the Thomson-Houston Company from £40,000 to £200,000, which sounds very much like an old-time statement of the parent American Company.

The Austrian Government is completing the work of building the telephone line between Berlin and Vienna, and it is expected that it will be completed this year. It will pass through Prague, Bodenbach and Dresden, the total length being about 400 miles.

The Corporation of Wolverhampton, England, advertise for "a working foreman engineer for their electric plant, at a commencing salary of £2 per week." Applications have to be sent in by noon on July 14. Which shows how much American engineers have to be thankful for.

It is stated that new clusters of *ficus elastica* (caoutchouc) have been discovered on the Rivers Verde, Tarvo, Itenes, San Martin, Paraguay, and their tributaries in the Bolivian Republic.

Immense quantities of manganese are said to have been discovered in the Caucasus Mountains between the Black and Caspian Seas, and European capitalists affirm that they will be able to deliver manganese at the port of Baltimore at $9 per ton.

A special mouthpiece for public telephones is being introduced in Germany with the object of avoiding the spread of diseases carried by the condensed moisture of the breath. A pad or a large number of disks of paper, with a hole in the middle, is inserted in the mouthpiece, and the upper disk of paper is torn off after every conversation. Our German brethren evidently have taken the telephone bacilli scare seriously.

It is reported that Messrs. Siemens & Halske, of Berlin, intend to establish an electrical plant in the Witwatersrand mining district of South Africa, to supply electrical energy for pumping, boring and other purposes in the mines.

The British Government has conferred a pension of £50 per year upon Mr. S. A. Varley as a testimonial to the public value of his scientific work.

Mr. Ludwig Mond, F.R.S., having purchased the necessary property adjoining the Royal Institution in London, will build and thoroughly equip a splendid laboratory to be known as the "Davy-Faraday Research Laboratory of the Royal Institution," turning it over as a gift to the institution, and also providing funds for its maintenance.

What Won't He Do Next?

We clip the following from a contemporary, and it must therefore be authentic. But what puzzles us is the doubt implied in the phrase "if he can do what he is trying to do." If he wants to grease ships why don't he do it and be done with it? A ship is bigger than a pig and greased pigs are features of all our country fairs. Edison's job of greasing a ship and its avowed object are exactly the same, differing only in magnitude:

"Edison is now at work with a plan to grease the sides of ships so that they will slip through the water more readily. He says the friction of salt water and its constituents is much more than is generally believed, and if he can do what he is trying to do, the Campania can make the voyage between New York and Liverpool in four days."

Leonard's Electric Heater Patent.

Mr. H. Ward Leonard has just had issued to him patent 522,718, of July 10,1894, for an electric heater which is likely to mark a very distinct advance in this line. The invention is quite radical and the patent obtained by him contains very broad claims. The first claim reads as follows: "A device in which electrical energy is converted into heat, having a thinly insulated conductor embedded in and completely surrounded by, a closely applied mass of metal substantially as set forth."

It is well known that by sending current through a resistance the entire electrical energy can be converted into heat, and as regards the efficiency of the conversion of electric energy into heat therefore no improvement can be effected. The utilization of the heat developed by the passage of the current through the resistance, however, presents great possibilities of improvement. It is very important for the operation of such tools as electric soldering irons, flat-irons, embossing irons and many other similar tools, some of which are used in almost every industry, that the heat developed in the resistance shall be conducted to the working surface as rapidly as possible and with the least amount of waste.

The necessity of a resistance which would stand a very high temperature has been such that platinum wire is often used in the construction of such tools, the expense of which is of course extremely high, but even this has failed under some conditions.

In Mr. Leonard's invention the resistance, which is a metal wire, is thinly coated with some form of fire-proof insulation, which hermetically seals the conductor from the air. The wall of insulation around the conductor is quite thin. The conductor so insulated is placed in a mould and a suitable metal is cast about the insulated resistance so as to completely imbed it in the cast metal This surrounding body of metal as it cools subjects the insulated conductor to strong pressure, insuring perfect mechanical contact throughout. The surrounding metal also hermetically seals the resistance from any possible contact with the air and from all chemical action. While the insulation surrounding the conductor is of comparatively poor quality as a conductor of heat, the wall of this insulation is so thin that it affords the least possible resistance to the flux of heat from the heated resistance, consequently the temperature of the heated resistance and the temperature at the surface of use will be as nearly the same as possible, and the resistance is therefore not subjected to a temperature appreciably higher than that of the surface of use.

The Carpenter Enamel Rheostat Company, of which Mr. Leonard is president and holds the controlling interest, will manufacture a great variety of apparatus under this patent.

The "Ellerslie."

The "Ellerslie" Hotel, 207 Third avenue, Asbury Park, N. J., is conducted this year by J. P. Hamblen, Jr., who is well qualified from experience and personal characteristics to keep a hotel and entertain his guests in good style. Being ably assisted by his wife and mother—both estimable and agreeable ladies—the patrons of the house may be certain of obtaining all the comforts of a well-ordered seaside residence. The house is finely situated, on one of the best streets, and being within a stone's throw of the beach, affords a wide view of the ocean. The Electrical Casino is nearby.

The Partridge Carbon Company.

The Partridge Carbon Company of Sandusky, O., which has been doing a thriving business from the first week of its operations to date, is running a full force on full time, with plenty of orders ahead. This company has made a specialty of motor brushes, in which line it excels, supplying at the present time nearly all the leading roads in the country.

Buckeye Lamps in New York and New England.

The Buckeye Electric Company of Cleveland have appointed the Manhattan General Construction Company, 50 Broadway, this city, their exclusive agents for Massachusetts, Rhode Island and Connecticut. The Manhattan Company are also the agents for New York and vicinity.

INCORPORATIONS.

The Great Kanawha Falls Water Power, Electrical Manufacturing and Land Company, Charleston, W. Va.—to utilize the water power of the Great Kanawha Falls and River for the production and transmission of electric power, light, etc. Capital stock, $2,000,000. Promoters: Oliver A. Patten, W. W. Tompkins, W. D. Scott, all of Charleston.

Fire Alarm Construction Company (incorporated in West Virginia), New York City—to construct, acquire, own and operate systems of electric and other fire alarms, etc. Capital stock, $100,000. Promoters: Leopold Wallach, Henry M. Cross, Maurice Maas, all of New York City.

The United States Electric Forging Company (incorporated in West Virginia), New York City—to deal in electrical apparatus for the heating of, forging, welding and otherwise treating of metals, etc. Capital stock, $1,000,000. Promoters: Edwin Garsia, H. J. Fredericks, New York City; A. C. Garsia, Arlington, N. J.

The Keyser Electric Light Company, Keyser, W. Va.—to manufacture and generate electricity and distribute and transmit the same for lighting streets and power purposes, etc. Capital stock, $50,000. Promoters: F. M. Reynolds, J. M. Templeton, Andrew Keenan, all of Keyser.

The Citizens' Telephone Exchange Company, Jersey City. Capital stock, $150,000. Incorporators: Franklin Noble of Jersey City and Joseph A. Thompson and A. R. Davenport of New York.

The Grand Rapids Machinery and Electric Company, Grand Rapids, Mich.—to buy, sell, manufacture and repair all kinds of machinery and electrical goods. Capital stock, $10,000. Incorporators: Charles W. Chauncey, John B. Hall, Stephen Christie and others.

The Lockport Gas and Electric Light Company—to furnish gas and electricity for public and private uses in Lockport, N. Y. Capital stock, $150,000. Directors: Augustus H. Ivins, S. Curtis Lewis, Herbert J. Chadwick, Eugene M. Ashley of Lockport; Emerson McMillan, Henry H. Wilson of New York City, and Benman Blanchard of Boston.

The Elizabethtown Electric Light Company, Elizabethtown, Pa. Capital stock, $10,000.

Montgomery Electric Light and Power Company, Montgomery, Ill. Capital stock, $10,000. Incorporators; Lysander Hord, Jr., John G. Habermeyer, William C. Weise.

New Athens Electric Light and Power Company, New Athens, Ill. Capital stock, $4,500. Incorporators: Isfried Probst, Paul Lehman, Frank W. Feuerbacker.

At Columbus, Ohio: The Cleveland Storage Battery Company, capital stock, $150,000; the Sandusky Telephone Company, Sandusky, capital stock, $30,000; the Standard Telegraph and Telephone Company to run lines from Cleveland through Lorain, Huron, Seneca, Allen and Van Wert Counties to the State line; capital stock, $50,000. The incorporators include Frank Rockefeller, F. B. Squire, and other members of the Standard Oil Company of Ohio.

The Universal Electric Messenger Call Company, Portland, Me.—to manufacture and deal in electric and mechanical appliances, especially the Messenger Call System for buildings. Capital stock, $100,000. Promoters: Elroy F. Cross, Charles B. Perkins, Thos. B. Wilson.

The Cincinnati Electric Service Company, Cincinnati, O.—to build or acquire and operate a system of electric lines with a view of extending telephonic communication and other electric service among its patrons. Capital stock, $10,000. Promoters: M. T. Corcoran, Wm. Cullen, John Francis Dougherty, E. D. Whitehead, P. J. Corcoran.

The Pittsburg, Frontenac and Suburban Electric Railway Company, Pittsburg, Kan.—to maintain and operate a system of railways for the purpose of carrying passengers and freight by steam, electricity or any mechanical power within Crawford County, Kansas; to construct and operate an electric plant for furnishing light, heat and power, etc. Capital stock, $75,000. Promoters: Herbert Simons, West Chester, Pa.; Samuel Barratt, Bobt. Robyn, A. L. Chaplin, all of Pittsburg, Kan.; L. M. Bodell, E. W. Minturn, Carl J. Simons, Chetopa, Kan.

The Faries Manufacturing Company, Decatur, Ill.—to manufacture check rower wire, window display fixtures, electric light holders and to do a general metal manufacturing business. Capital stock, $50,000. Promoters: Robert Faries, Wm. E. Surface, E. P. Irving.

The Seattle Home Telephone Company, Seattle, Wash.—to do a telephone, telegraph and general electric business in the State of Washington and other States. Capital stock, $100,000. Promoters: J. H. McGraw, J. D. Lowman, A. B. Stewart, A. M. Brooks, George F. Gund, Seattle.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JULY 17, 1894.

ELECTRIC RAILWAYS AND APPLIANCES.

523,101. Electric-Railway Supply System. William A. Butler, New York, N. Y., assignor to John Gilmore Boyd, same place. Filed March 16, 1894.

523,146. Conduit Electric Railway. Charles D. Jenney, Indianapolis, Ind. Filed March 5, 1894.

523,163. Trolley. Joseph Guzowski, Chicago, Ill. Filed Jan. 13, 1893.

523,164. Supply System for Electric Railways. Edward H. Johnson, New York, and Robert Lundell, Brooklyn, assignors to the Johnson Subtrolley Company, New York, N. Y. Filed Dec. 19, 1893.

523,165. Supply System for Electric Railways. Edward H. Johnson, New York, and Robert Lundell, Brooklyn, assignors to the Johnson Subtrolley Company, New York, N. Y. Filed Jan. 16, 1894.

523,166. Supply System for Electric Railways. Edward H. Johnson, New York, and Robert Lundell, Brooklyn, assignors to the Johnson Subtrolley Company, New York, N. Y. Filed Feb. 10, 1894.

523,172. Electric-Railway Crossing-Insulator. Henry B. Nichols and Frederick H. Lincoln, Philadelphia, Pa. Filed May 9, 1894.

523,271. Conduit Electric Railway. John W. Eisenhuth, San Francisco, Cal. Filed March 12, 1894.

523,278. Electric Rail-Bond. James G. Hallas, Waterbury, Conn., assignor to the Benedict & Burnham Manufacturing Company, same place. Filed May 1, 1894.

523,284. Bonding-Joint for Electric Railways. Andrew L. Johnston, Richmond, Va. Filed May 5, 1894.

523,306. Electric Railway. Henry A. Doty, Janesville, Wis., assignor to Mary E. Doty, same place. Filed March 27, 1894.

523,313. Electric-Railway System. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company of Boston, Mass. Original application filed April 28, 1886. Divided and this application filed March 14, 1889.

523,319. Electrical Conductor for Trolleys. John W. Eisenhuth, San Francisco, Cal. Filed June 21, 1893.

ELECTRIC LIGHTS AND APPLIANCES.

522,964. Manufacture of Incandescent Electric Lamps. Henry D. Burnett, Lynn, and Samuel E. Doane, Swampscott, Mass., assignors to the General Electric Company, of New York. Filed Dec. 3, 1892.

523,007. Electric-Lamp Support. James J. Renehan, New Britain, Conn. Filed Nov. 21, 1893.

523,144. Electric-Arc Lamp. Walter E. Frost, Lewiston, Me., assignor to Daniel A. Field, same place, and Geo. P. Smith, Auburn, Me. Filed July 31, 1893.

523,204. Incandescent Electric Lamp. William E. Forest, New York, N. Y., assignor to the Livgro Incandescent Lamp Company of New Jersey. Filed Aug. 1, 1893.

523,264. Material for Making Electric Light Filaments. Gustave A. Carnot, London, England. Filed Dec. 12, 1893.

523,305. Incandescent Electric Lamp. John E. Criggal, Springfield, Mass., assignor to the Davis Electrical Works, same place. Filed June 11, 1894.

MOTORS, DYNAMOS, ETC.

522,986. System of Electric Distribution and Generation. Edwin J. Houston, Philadelphia, Pa. Filed Nov. 17, 1887.

522,988. Method of and Apparatus for Transforming Alternating into Continuous Currents. John F. Kelly, Pittsfield, Mass., assignor to the Stanley Laboratory Company, same place. Filed Jan. 6, 1894.

523,019, Commutator for Dynamo-Electric Machines, Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company of New York. Filed Feb. 10, 1894.

523,027. Armature Bar and Method of Making Same. George Weber and Charles W. Marcley, Rotterdam, N. Y., assignors to the General Electric Company, Boston, Mass. Filed Dec. 22, 1893.

523,119. Quadruplex Neutral Relay. Charles D. Haskins, Brooklyn, N. Y., assignor to the Western Electric Company, Chicago, Ill. Filed April 3, 1893.

523,140. Electric Motor. Julian F. Denison, New Haven, Conn., assignor to the Backus Manufacturing Company, of New Jersey. Filed April 6, 1894.

523,247. Magneto Electric Machine. Ernest Tilman, New York, N. Y., assignor of one-half to Charles K. Lexow, same place. Filed Nov. 22, 1893.

TELEPHONE AND TELEGRAPH APPARATUS.

523,132. Magneto Call Box. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Nov. 6, 1891.

523,276. Telephone Transmitter. Theodore Grissinger, Mechanicsburg, Pa. Filed May 24, 1894.

523,312. Order Case for Telegraph Operators. James A. Hudson, Buena Vista, Col. Filed Jan. 8, 1894.

BATTERIES, ETC.

522,983. Galvanic Battery. Gardner Hewett, New York, N. Y., assignor of four-fifths to Wm. Heaton Longsdorf, same place. Filed Sept. 19, 1893.

523,055. Process of Making Battery Plates. William L. Silvey, Dayton, Ohio. Filed Sept. 9, 1892.

SIGNALS AND SIGNALING APPARATUS.

523,120. Electric Signaling Apparatus. William W. Hibbard, Rochester, N. Y., assignor to the Standard Electric Signal Company, same place. Filed August 12 1893.

523,121. Electric Signaling Apparatus. William W. Hibbard, Rochester, N. Y., assignor to the Standard Electric Signaling Company, same place. Filed Aug. 12, 1893.

523,122. Differentiating Apparatus for Electric Signal Systems. William W. Hibbard, Rochester, N. Y., assignor to the Standard Electric Signal Company, same place. Filed Aug. 12, 1893.

523,123. Electric Signal Box. William W. Hibbard, Rochester. N. Y., assignor to the Standard Electric Signal Company, same place. Filed Aug. 12, 1893.

523,124. Electric Signal Box. William W. Hibbard, Rochester. N. Y., assignor to the Standard Electric Signal Company, same place. Filed Aug. 12, 1893.

MISCELLANEOUS.

522,999. Electrical Connection Cord. Alfred H. McCulloch, Boston, Mass., assignor to the American Bell Telephone Company of Massachusetts. Filed Feb. 6, 1894.

523,026. Diaphragm for Electrolytic Cells. Charles N. Waite, Rumford, Me. Filed Aug. 12, 1893.

523,074. Electric Switch. Jesse F. Kester, Buffalo, N. Y., assignor to the F. P. Little Electrical Construction and Supply Company, same place, Filed Nov. 28, 1893.

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EDITORIAL NOTES.

The Culm Bank vs. Niagara Falls.

From almost the beginning ELECTRICITY has been opposed to the project of transmitting the energy of Niagara Falls to distant points Our opposition has not been an opposition to electrical interests, but in behalf of them. The whole scheme was conceived and has been carried out thus far in the same spirit that actuates the confidence man. It was Barnumized in the beginning by the appointment of the so-called International Commission of which Sir William Thomson (Lord Kelvin) was made president for the purpose of attracting attention solely. This commission, though composed of good men, was the brass band playing in front of the tent to attract the attention of the little boys, and it accomplished nothing whatever of value either to the cause or to electrical science. After the band had stopped playing came the barkers, and a celebrated English engineer was called upon to fill that position and he has filled it ever since. When the curtain rose and there appeared what he had to show, there happened exactly what often happens at little folks' shows—the animals and the acrobats did not come up to the pictures in front of the tent or to the barker's glowing description which had enticed the audience in, and they fell upon that barker and he barely escaped with his life. Later on two American engineers (?) tried the same game in America, and published in one of our contemporaries "an estimate of the distance to which Niagara water power can be economically transmitted by electricity," and every one who has thought it worth while to speak of their estimate criticised it most rigorously, following the lead of ELECTRICITY which first called attention to the many discrepancies. We do not wish to be misunderstood in this matter. We are accusing Houston and Kennelly and Forbes neither of duplicity nor of dishonesty—they are all three of them above any such imputation; but they have strangely allowed themselves to become the tools of an unscrupulous organization which was fathering a scheme that these gentlemen with their experience in electrical matters should have known was impracticable at least with our present knowledge. The formation of the Cataract General Electric Company, with the avowed purpose of using the canal banks for their lines to supply the various cities and towns along the route from Buffalo to Albany, was without doubt a fake of the first water; but these engineers were called upon to make an attempt to show the practicability of such a scheme. No other electrician, however, has been found to agree with them. The canal bill was part of a scheme ostensibly to grant the company the right of way but in reality to give them a monopoly of the right to erect central stations throughout that extensive territory lying along either side of the canal between Buffalo and Albany.

Electricians—we mean electrical engineers—have long since realized that waterfalls as sources of power are apt to be *ignis fatui*; they look as though they would furnish power for nothing, but too often the investment required to make them available is so great that the interest on it and the cost of maintenance make the power cost more than it can be furnished for by steam. At Niagara the cost of rendering the power available was enormous and could only be justified by an enormous output. It seems likely that for several years to come the company will have to furnish power, even at Niagara Falls, at a loss to compete with steam.

But why should the attempt to utilize Niagara ever have been made, if it were not for mere spectacular effect, when power could be generated more cheaply at another point by steam, with an infinitely larger market nearer at hand? We refer to the culm banks at the coal mines in Eastern Pennsylvania.

Houston and Kennelly say in their paper: "It is clear that if reliable machinery could be purchased cheaply enough, and the conductors could be safely operated at sufficiently high pressure, the Falls of Niagara could to-day stop steam engines in New Orleans, La., by underselling their power." This is true, but it is equally true that under the same conditions the culm banks of Eastern Pennsylvania would drive the power from Niagara Falls out of New Orleans.

Desiring to have some accurate data on the cost of power derived from culm, we wrote to Mr. D. B. Atherton, secretary of the Scranton Board of Trade, on June 23 last, and under date of June 25 we received a reply of which the following is an abstract:

Editor of ELECTRICITY:

In reply to yours of the 23d inst., I take pleasure in presenting below a few statistics, showing the cost of anthracite fuel per horse-power per year for steam purposes in Scranton, Pa., as taken from the books of several manufacturing concerns in this city, and comparing the same with cost of electric power to be furnished by the utilization of the great Niagara.

I base my calculations on actual results and not on theory, and have taken establishments with unimproved plants (boilers, engines, etc.), as well as those with modern improvements, in order to arrive at the exact actual cost.

For the first six months in 1892, concerns with improved plants employing 8,760 horse-power, used 394 tons of fuel per day of 24 hours during; the same time concerns with unimproved plants, employing 7,362 horse-power, used 450 tons of fuel per day of 24 hours. We therefore find that 844 tons of fuel produced 16,122 horse-power each day. This fuel costs 25 cents per ton delivered at boilers, or a total of $211 per day for the 16,122 horse-power, or 1.31 cents per horse-power per day, and for 300 working days the total cost of fuel per horse-power per year to these concerns was $3.93.

Now, then, let us compare the above figures with those of the company who propose to use the power of the great Niagara for the purpose of supplying electric power to manufacturers at Buffalo and the surrounding country.

From a circular published in Buffalo, entitled "Buffalo and Niagara Power," I quote the following: "Niagara will furnish power for a day of 24 hours for an average price of $15 a year per horse-power." This is no doubt cheap as compared with the present cost to concerns in Buffalo who use anthracite or bituminous coal for fuel, but please compare it with the cost of anthracite culm. To develop 16,122 horse-power at $15 per year, as quoted by the Niagara company, would be $241,830. In Scranton it actually cost $63,359.46. Add to this the cost of firing, interest on plant, repairs, etc., which in round numbers is $2 per horse-power per year, and we have an actual cost of $95,603.46, or a net saving over Niagara of $146,226.54.

We have here an inexhaustible supply of this kind of fuel, and its utilization for steam purposes has passed all experimental stages and its use is becoming more general every year.

D. B. ATHERTON, Secretary.

Now here is the question: If power costs $15 per horse-power at Niagara, or half that, and only $3.93 per horse-power per year at Scranton or any other of the coal mining towns, how is Niagara to compete with the culm bank over any territory of the same radius?

We find by consulting the map and by rough estimates of distances that all points east of Syracuse are nearer to Scranton than they are to Niagara, so that if power could be produced as cheaply at Niagara as at the culm bank, the latter would drive out the former even at Syracuse.

There is another point which will be self-evident. If the problem was how to reach the greatest number of customers within a given radius, Niagara as compared with the culm bank would be entirely out of the question. To compete at all with the culm bank, Niagara would have to have some marked advantages which we do not see that the present electrical scheme possesses.

The folly of the present position is probably not at all due either to the false International Commission or to the engineers now in charge. The problem given to them was, "How can we best utilize the power of Niagara?" They have gone to work on this problem and have tried to make a good case out of a bad one, and have stretched their figures a little to do this, but one needs only to look at the map of Pennsylvania and New York to see that a large part of the territory which they claim as legitimately within the field of Niagara can be reached by much less distances from the culm bank. And as to the possible customers within the reach of either of these centers the culm bank has far and away the advantage. The Greater New York, for instance, which is only 145 miles from Scranton, possesses more possible customers than all of the country between Niagara and Albany, 330 miles distant, and on the way to New York are a number of large manufacturing towns, such as Paterson and Newark, either of which latter would probably consume as much current as any of the cities mentioned in connection with the Niagara project.

We have said that we believed that the Niagara plant would have to furnish power at a loss even at Niagara for some years to come if they sell it at $15. Take a lead pencil and figure it out for yourselves. We do not know what the invested capital is, but it cannot be short of $3,000,000. This should earn for itself 6 per cent. in order to avoid loss.

Six per cent. on $3,000,000 is $180,000. To earn this at $15 per horse-power would require the selling of 12,000 horse-power. This is not counting in depreciation, etc., which should be between 10 and 20 per cent. at least. Niagara is not now prepared to purchase that amount of power from the company in the face of its present hydraulic facilities. Until at least 15,000 horse-power are sold on a cash basis the Niagara plant will work at a loss. We think the project ill advised and foredoomed to failure. We believe it is a failure already and that the insiders know it and are only waiting for an opportunity to unload upon an unsuspecting and credulous public. Our advice is, and we think it will be the advice of every intelligent engineer, that if you want to invest in a project of this kind, go to the culm bank.

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A Bolometer Study of Light Standards. Elsewhere in this issue we give the first part of a very interesting article on "A Bolometer Study of Light Standards," by Clayton H. Sharp and W. R. Turnbull, which we have clipped from *The Physical Review*. This subject of obtaining a standard of light that shall be reliable is one that is attracting the attention of physicists now more closely than at any previous time, and it is a problem that has so many sides to it, viz., there are so many disturbing influences to be guarded against or for which corrections must be made, that any new method suggested will naturally be critically examined before it is accepted.

A bolometer, as our readers know, is an exceedingly delicate instrument devised by Prof. Langler for measuring small quantities of radiant energy, of which light is but one form. It is known that of all the radiant energy surrounding even the best argand burner less than 1 per cent. of it is useful for illuminating purposes. It therefore occurs to us that any method for measuring that portion of radiant energy useful for illuminating puposes, depending upon the measurement of the total radiant energy sent out, is open to very serious objections. Then during the past few years we have become practically acquainted with a new form of radiant energy, viz., the Hertzian oscillations, which has shown itself capable of producing marked disturbances in properly constructed apparatus, and Prof. Oliver Lodge has recently devised a very simple apparatus for detecting such oscillations. Now it is quite conceivable that Hertzian oscillations, which by the way are not light vibrations in the sense in which we must use that term here, might easily vitiate any results arrived at by the bolometric method or any other that was sensitive to radiant energy of all kinds. The authors admit many sources of error in their method, but think they may be neglected. Among these are thermo-electric disturbances; but they apparently think that the influences of the heat effects on their german-silver resistances are also negligible. It is a very common mistake to assume that this metal is a constant quantity either in its thermal or electrical qualities. It is not even a definite alloy, and while often spoken of as having such and such a heat coefficient, practice has shown that two samples can scarcely be found whose heat coefficients correspond. This has been explained by the disclosures of chemical analysis, which have shown that the chemical composition of different specimens varies between very wide limits. Now it happens that we have at least two alloys of practically negligible heat coefficients and one whose heat coefficient is really a negative quantity, which would certainly seem to be preferable in all respects to germansilver as resistances where the major portion of the radiant energy to be measured happens to be in the form of heat. Another fundamental objection to the present method that suggests itself is that it necessarily depends for its action upon something that we don't want to measure at all, viz., heat. The method, however, seems to have been carefully worked out, is exceedingly ingenious and interesting, and we give a full abstract for what it is worth.

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A Gas Engine Query. The use of the gas engine for electrical purposes is an old story abroad but a new one here. A few isolated plants have in fact been installed, but the field is a large one, and as yet entirely uncultivated. None of the gas engines are advertised in the electrical papers, and they may therefore be regarded as an unknown quantity in electrical circles. One of these days some enterprising manufacturer will make his engines known to the electrical fraternity and reap a rich harvest.

Others will of course follow, but the first in the field will already have so fortified his position as to be difficult to displace. Another thing will also happen. The manufacturer who wishes to gain custom will instruct his agents to give some tangible information to inquirers. As it is now, it is almost impossible to get a price on a gas engine; there are no price lists published and if one inquires for figures he has to give his whole history before they will be given.

The largest manufacturer of gas engines in this country has an agency in New York, but if you apply there for information you are met with an impertinence that a self-respecting man will not stand. In other lines of business an inquirer is met with courtesy, but in this particular agency it is the reverse. Can the principals in the business afford to keep such a man in their employ? Our advice is to get down to business, employ gentlemanly agents and authorize them to give all the information that is desired—and cultivate the electrical field.

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Correction. By mistake the illustration on page 8 (issue of July 18), accompanying Mr. Vail's "The Development of the Electric Telegraph," was labelled "The Speedwell Works, 1838." It should have been labelled "The Old Factory." The historical interest in this old factory lies in the fact that it was in the second story of this building, which consisted of a single large room, that the first message with the new instrument was sent and received. The sentence was, "A patient waiter is no loser." This was on January 6, 1838. The circuit consisted of something more than three miles of wire supported on the walls of this room.

Dr. Siemens Endorses Our Opinion of Houston and Kennelly's Niagara Falls Transmission Estimate.

In reply to a question asked by the reporter as to his opinion of the feasibility of using Niagara Falls for generating electrical power, Mr. Alex. Siemens said that it was his uncle, Sir William Siemens, who first thought of using the falls for that purpose. Sir William and Mr. Siemens had been at the Philadelphia Centennial Exhibition in 1876, and on their way back they visited the falls. "What a power is going to waste!" Sir William exclaimed, and in an address, which in the same year he delivered before the Iron and Steel Institute, he made a series of calculations which are still in use upon the subject. Some years ago, Mr. Siemens said, he was consulted by the Cataract Construction Company and came to the conclusion that they could sell power in the immediate neighborhood for $25 per horse power per year and for $50 per horse power per year in Buffalo. Taking the distance of Toronto from the falls as 60 miles, the cost would be $112.50 per horse power per year. A cable could easily be laid across the lake that would be perfectly safe and that would likely last for years.—*Toronto Globe.*

Can any one be found to endorse Messrs. H. and K.'s estimate? It begins to look as though all one had to do to get employment by the Cataract Construction Company was to make some estimate of the possibilities of the scheme with which no sane man could possibly agree. Forbes laid out plans which were most unmercifully criticised by his colleagues of the Institution of Electrical Engineers and his services were retained. Houston and Kennelly made an estimate which has been torn to pieces, first by us and afterwards by half a dozen of the best practical engineers in this country, and they are retained by the company. When we get out of a job we propose to figure out the possibility of transmitting the energy of the falls to Switzerland to compete there with native Alpine falls. We are willing to wager that we get a job right off.

BOOK REVIEW.

Electrician's Manual of Diagrams. By E. W. Smith. Philadelphia: Scientific Publishing Co. Price, 50 cents.

This little book, 4x5 inches in size and 93 pp., is unique, so far as we know, in electrical publications. We cannot say in literature, for its uniqueness consists in its containing no literature at all, unless the introductory remarks, consisting of a dozen lines, and the captions of the cuts may be regarded as such.

The work contains in its 93 pages 45 full page plates, the pages facing the plates containing in a few words the explanation of the opposite plate. Thus on page 45 is found Plate 21, and on the opposite or facing page, 44, the legend, "Plate 21 shows one end of telegraph with relay for long distance. When the line wire is grounded the instruments are connected for practice."

The plates, in black with lines in white, cover a very wide range—70 in all--and are exceedingly well executed and clear. The little book will prove of great assistance to amateurs in the field it covers.

"Was Moses an Electrician?"

BY THOS. D. LOCKWOOD.

In Electricity of July 25 is an article purporting to have been written by C. B. Warrand, and bearing as a title the question, "Was Moses an Electrician?"

Moses may or may not have been an electrician, since he was educated in all the learning of the Egyptians, but since the particularly nebular hypothesis of Mr. Warrand is, so far as the record is concerned, quite without warrant, and depends for any value it may possess on manifest inaccuracies of statement, the candid reader is advised that there is not any necessity for him to reform his views regarding Moses and the Israelites at present.

1. The article begins by saying "There is no doubt that electricity was well known to the Israelites." There is a good deal of doubt; the Israelites on their way from Egypt were a collection of wandering nomads, quite devoid of homogeneity, and that they had little knowledge of any kind is clear from the particularity with which their leader lays down his rules for their conduct.

Paragraph 2: "Moses had the fir-box lined outside and inside with beaten gold, which converted the ark of the covenant into a . . . . Leyden jar. . . . . So much is certain, that if Edison or Tesla had lived in those days they could not have improved on the choice of material, and the result was a powerful Leyden jar."

This is utter rot. Brass, of which the Israelites had plenty, would be quite as good as gold for a Leyden jar conductor; and—shade of Musschenbroek—think of fir wood for a dielectric!

Paragraph 3: "A fire of material rich in carbon was kept burning on top of the ark of the covenant."

No such statement is to be found in the record, which on the contrary says: "Thou shalt make a mercy seat of pure gold; . . . . thou shalt put the mercy seat above upon the ark" [clearly, for a cover];—"and there will I meet with thee and I will commune with thee from above the mercy seat." (Exodus xxv., 17-22.)

Not a word about fire on the ark cover; on the contrary, a lid of gold, which, if the upper edge of the ark were not already covered with the overlapping edges of the inner and outer coatings of the box, would unite them, through its substance; so that the imaginary Leyden jar would, so to speak, be short-circuited.

Paragraph 4: "After Moses's death, his brother Aaron took the matter in hand, and greatly improved the electrical power of the storage battery." This seems to be a new case of "when *I* died, they buried Brother John," for, referring once more to the record, we find that Aaron died first, while the people were yet wandering: "They went up into Mount Hor in the sight of all the congregation, ... and Aaron died there, and Moses came down from the mount." (Numbers xx., 27-29.) Moses on the other hand did not die until the border of Palestine was reached, long after. (Deut. xxxiv., 1-8.)

Then follow a lot of statements ostensibly taken from the Scriptures, but which are not to be found there, all tending to support the electrical attributes of the ark. They are not worth following out, and it is sufficient to suggest that the *falsus in uno falsus in omnibus* rule applies to this case. And we find that the remarkable powers of the ark followed it when it was captured by the Philistines, for when the gentry last named placed it in front of their god Dagon as a trophy, it not only accomplished the overthrow of the said god, but actually went on to afflict its captors with a certain unpleasant disease, and these manifestations appeared when the quasi-Leyden jar was no longer under the care of the supposed experts. (I Samuel v. and vi.)

Paragraph 8: "Solomon in building his temple advanced one step further; he found that copper would do as well as gold. He had the temple covered with copper," etc.

Strange that the Israelites, to whom electricity was so well known, had to wait until the time of Solomon before they found that it was not necessary to squander their gold when they wanted a conductor of electricity, and that copper was as good or better! Their action seems to have savored something of the method by which according to Charles Lamb the Chinese formerly acquired the delicacy of roast pig.

It is therefore greatly to the credit of Solomon that he made the advance stated —if he made it,—for it was a discovery equal to that of Steinheil. But, alas, we find (I Kings vi., 21 and 22) that "Solomon overlaid the house within . . . . and the *whole* house he overlaid with gold until he had finished all the house." The alternative account is still more particular, and says: "He overlaid also the house, the beams, the posts, and the walls thereof, and the doors thereof with gold." (II Chron. iii., 7.) There is not a word about copper in the whole story.

The entire article seems to have been compiled or composed by some enterprising paragrapher who, too lazy to look up his facts for himself, felt satisfied that no one else would, and made up his mind that even though somebody should look through the record he did not care. I have, however, thought it worth while to call attention to its mis-statements for the reason that the non-technical press is certain to give the article wide circulation under the head of Electrical Science, and I wished the antidote to be at least accessible.

The Fiume Chamber of Commerce are petitioning the Hungarian Minister of Commerce to establish a telephone line between Fiume and Budapest, and ultimately between Fiume and Trent.

A Bolometric Study of Light Standards.

BY CLAYTON H. SHARP AND W. R. TURNBULL.

I.

Introduction.

The two great essentials for a light standard are constancy during use and exact reproducibility.

It is evident to a most casual observer that the standard candles which are in use do not possess the first of these essentials. The English standard candle has been charged with fluctuations of 40 per cent., and it is only by snuffing and measuring carefully the height of flame that anything approaching uniform results has been obtained.

The Carcel lamp has stood the test of time but little better than the best of standard candles. It has disadvantages entailed by the use of a light-absorbing chimney and a rapidly charring wick; while of its reproducibility, within a reasonable margin of error, there is serious question. Although the Carcel lamp furnishes a very steady source of light, it is known to show slow changes in the amount of light emitted, rising slowly to a maximum as the lamp and oil become heated and then falling off with the charring of the wick.

Among the more modern standards that of Methven is faulty in that it requires a chimney, employs as an illuminant an indeterminate mixture of gases, and is affected also by variations in the pressure of the gas and by draughts of air in the room. The Vernon-Harcourt pentane burner and the Hefner-Alteneck amylacetate lamp, while avoiding this difficulty, run into others perhaps equally serious. The open flame of the latter is not only of a decidedly reddish hue, but is also extremely sensitive to draughts and vibrations of the air. On this account it is only with the greatest care that the height of the flame can be adjusted according to the prescription.

Many attempts have been made to determine the fluctuations of the various standard lights by comparing them by means of a photometer with a source of constant light; as, for example, a glow-lamp at constant voltage. This method is very faulty on account of fundamental difficulties of a physiological or psychological nature which are met in the use of even the most perfect photometer. It requires care and deliberation to make a photometer setting which can be relied upon as being correct within a narrow limit of error, while the fluctuations in the intensity of the light may be quite rapid.

If one seeks to determine these fluctuations by independent settings, succeeding each other as rapidly as reliable settings can be made, the extreme fluctuations may escape observation. The consequence is that no very definite idea can be obtained of the form of the curve which would be traced by the changes of the light intensity. On the other hand, if continuous observations are made with the photometer, it is possible to follow up the fluctuations only very tardily, irregularly and imperfectly.

In any case the personal error of the observer enters so largely into photometric results that the perplexing question is continually arising, Have I really observed a fluctuation of the light, or have I merely made a bad setting? This remark applies, of course, only to the smaller fluctuations, and not to the large ones commonly observed in the case of candles.

In order to determine these fluctuations, an instrument is needed which will not only serve to measure radiant energy, but which will also respond instantly to any change in the amount of radiation meeting it. Such an instrument is found in the bolometer. Suggestions as to the use of the bolometer in photometry have not been infrequent. Lummer and Kurlbaum* have described a large double-faced bolometer of platinum foil, constructed by them for photometric work. It is difficult to see how this bolometer, intended as it was to be used among the fickle draughts and changing temperatures of a photometer room, would serve to get a continuous curve of the variations of a light standard by the method described below.

In order to get a complete knowledge of the performance of any light source, it is necessary to obtain a continuous record of its behavior during a considerable period of time. If we make the assumption that light radiation from a given source varies in direct ratio to the total radiation, a properly constructed bolometer furnishes a suitable instrument for obtaining the record desired. The bolometer strip must be so thin that its temperature will follow almost instantly all changes in the amount of radiation meeting it, and the galvanometer must be nearly dead beat. Then if the working conditions are such that it is certain that all observed galvanometer deflections are due to changes in the radiation from the light source and to nothing else, a plat of galvanometer deflections will represent very truly the variations in the intensity of the light.

The proper adjustment of conditions involves the very careful exclusion of draughts of air from the bolometer strips and from the other parts of the apparatus, and the maintenance of a nearly constant temperature in the room. Moreover, it necessitates the taking of observations at such a time or place that the galvanometer shall not be subjected to any irregular magnetic influences. In order to fulfil these conditions, the apparatus described below was constructed.

II.

Description of Apparatus.

After numerous unsatisfactory experiments with gold leaf lightly plated with nickel, with pure nickel, and with the thinnest tin foil, the bolometer strips were made as follows:

A piece of Swedish iron wire, of No. 30 B. & S. gauge, was passed through jeweler's rollers until its thickness was about 0.045 mm. and its width 1.5 mm. It was then placed in dilute sulphuric acid, in which potassium bichromate had been dissolved, and a current was passed through in such a manner as to dissolve the iron. The potassium bichromate was introduced into the solution to dispose of the hydrogen bubbles which would ordinarily have clung to the metallic surface and which would have caused it to be dissolved unevenly.

In this way a strip was obtained which was about 0.025 mm. in thickness and still moderately strong. From this strip were cut two pieces, each about 6 cm. in length, to constitute two arms of a Wheatstone's bridge.

To carry the strips so obtained, a light oblong frame, *F* (Fig. 1), of thin wood was made, and to it were fastened small bits of sheet brass, *b*, *b*, *b*, to which the strips and the copper wires intended to connect them with the other arms of the bridge could be soldered. The strips, *S*, *S*, were then bent and placed over the frame so that each strip crossed the frame twice. The free ends of each strip were displaced laterally from each other so that, when viewed from the front, the portion of the strip on one side of the frame hid only very little of the portion on the other side of the frame.

After the two strips had been arranged on the frame symmetrically with respect to each other, the one which was to receive radiation was carefully smoked on both sides. To accomplish this smoking without undue heating of the strip, a piece of sheet metal, through which a hole had been punched, was held over a candle flame so that the flame was caused to smoke. The smoke passed through the hole, over which a tube was held to direct the current. The strip was passed back and forth over the top of the tube. In this way a very delicate strip can be blackened without injury. In their completed state the strips had a resistance of about 0.5 ohm each.

The frame holding the strips was mounted in a wooden box about 20 cm. long and 5 cm. x 6 cm. in cross-section. A number of suitable cardboard screens were placed in the front portion of the box to shield one of the strips from radiation and to protect both of them from draughts. To close the box at its other end a piece of bright tin was cut equal in size to the cross-section of the box. This was soldered fast to a heavy block of brass to the other end of which was soldered another piece of tin which covered the end of the box. When this arrangement was placed in the box, the first piece of tin came close behind the bolometer strips, and its bright surface acted as a mirror in reflecting upon the back of the exposed strips many rays which would otherwise have been lost.

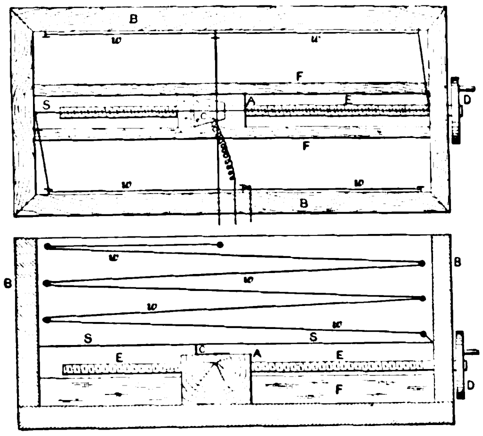

FIG. 1.

By this means the efficiency of the bolometer was nearly doubled. The tinned surface did not tarnish perceptibly during the course of the investigation. It was not smooth enough to reflect a distinct image, and the light reflected from it was to a large extent scattered. The use of a plane-surfaced mirror in such a position would not be allowable, since any slight change in the angle of incidence would cause a different amount of light to be reflected upon the bolometer strip. The use of the irregular-surfaced plate, since it diffuses the light, can scarcely affect the accuracy of the results to an appreciable degree in such work as has been done with this bolometer. Nevertheless, this arrangement is to be recommended only where great sensitiveness is desired rather than the most exact comparison of results.

Other sources of error which might affect the exact comparability of results have also been ignored. Among these may be mentioned the error which is introduced in assuming that the sensitiveness of the bolometer is independent of the absolute temperature of the strips. The brass block served to keep the temperature of the tin screen from rising to any marked degree above that of the air in the room, by conducting any excess of heat to the outer piece of tin, the surface of which was smoked.

The compensating resistance, forming the other arms of the bridge, was made of german-silver wire arranged inside a small wooden box. Fig. 2 gives the top and side views of this box. The german silver was strung back and forth on tacks nailed in the two sides of the box, as shown in the side view. The middle portion, *S*, of this wire was drawn tightly lengthwise of the box, and a sliding contact piece, *C*, was arranged to press against this wire. This contact piece was carried on a small block of wood, *A*, running on ways, *F*, *F'*, and driven by a fine-threaded screw, *E*, which could be turned by means of a large disk head, *D*, outside of the box. One terminal of the battery (which consisted of two gravity cells in multiple with each other) was connected with corresponding ends of the bolometer strips. The other terminal was connected with the sliding contact piece just mentioned. In order to adjust the balance of the bridge, it was necessary only to turn the screw and so move the contact piece along the stretched wire until a position was found where no current flowed through the galvanometer. This method was found to be very delicate and convenient.

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* Lummer und Kurlbaum, Wied. Ann., Vol. XLVI, p. 204. Zeitsch. fur Instrumentenkunde, Vol. XII, p. 81.

The compensating resistance was connected with the bolometer strips by means of copper wires. All metallic junctions which might give rise to thermal currents were, as far as possible, so arranged that currents produced in this way in any part of the bridge would be opposed by similar thermal currents produced in the opposite part of the bridge; this condition being secured by bringing corresponding thermo-junctions as near to each other as it was convenient to do.

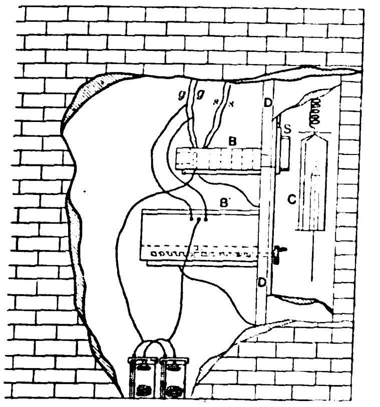

FIG. 2.

The galvanometer employed was of the four-coil type. It was constructed by Prof. W. S. Franklin after the same general plan as has been followed by Snow,[1] Paschen,[2] and others. When the two front coils were in multiple with each other and the two rear coils similarly connected, and the two pairs were connected in series, the resistance was found to be 190 ohms. The moving parts consisted of four little magnets of piano wire, each about 5 mm. long, and a mirror of thin cover glass, 4 mm. wide by 7 mm. long, all mounted on a slender rod of glass and suspended by a very fine quartz fiber. Any oscillations of the needles were very strongly and effectively damped by the air resistance to the light-moving parts,—a very essential condition to the correct operation of the instrument when used to get the variations of a rapidly fluctuating source of radiant energy.

The scale was divided into 100 half-inch divisions, each of which was in turn divided into tenths. The distance of the scale from the galvanometer was 100 scale divisions, i. e. 50 inches. With the telescope used, fifths of the smallest divisions could be estimated. In speaking of scale-divisions, the half-inch divisions will always be meant.

To determine at any time the sensitiveness of the arrangement, a plan was followed which was first proposed by Knut Angström.[3] In multiple with the exposed bolometer strip was placed a resistance of 1,000 ohms. By removing a plug and throwing 5,000 ohms more into the shunt circuit, the galvanometer needle was deflected in the same direction as when the strip was heated. Only the first throws of the needle were taken in observations for sensitiveness,—a procedure which a comparison of first throws and final deflections, at different degrees of sensitiveness, showed to be justifiable. The ratio of first throws to permanent deflections was found to be 1.5.

No attempt has been made to correct the determinations of sensitiveness for any variation of the ratio of resistance of the bolometer strip and that of the shunt, due to temperature changes. This would be a simple correction to apply if only one could ascertain the temperature of the strips at any time. Since, however, this temperature is a function, not only of the temperature of the room, but also of the strength of the main current and of the radiating power of the surface of the strip, a direct determination of it is impracticable. A value for this correction combined with the correction for the change in sensitiveness due to change in absolute temperature of the strip could have been ascertained by comparing deflections given by a source of constant radiation under different conditions of room temperature and current strength; but for the present work such refinements were deemed unnecessary, since the error introduced by not applying these corrections would form only a small proportional part of the quantities to be measured.

For observations requiring only a low degree of sensitiveness, the galvanometer coils were connected in the multiple-series arrangement described above. For higher degrees of sensitiveness all the coils were put in multiple, the increase in sensitiveness produced by this change being about two-fold. With either connection the fine adjustment of sensitiveness was obtained by changing the distance of a controlling magnet. In nearly all cases the sensitiveness of the bolometer was such as to permit the controlling magnet to be placed so as to strengthen the earth's field, and the period of the galvanometer needle was correspondingly short.

The constants of the galvanometer and of the bolometer were as follows: With the galvanometer coils in the multiple-series connection and the sensitiveness adjusted to give a throw of the needle of 16.2 scale divisions on putting the 5,000 ohms in the shunt (this being the standard sensitiveness for candles), the period of the needles was six seconds for a complete vibration. A deflection of one scale division corresponded to a current of 68×10^{-10} amperes.

This deflection of one scale division corresponded to a temperature rise in the bolometer strips of 0.00657° C. If we reduce this to millimeter divisions on a scale placed at a distance of 1 m. from the mirror, we see that one millimeter deflection corresponded to a current of 68×10^{-11} amperes, and the corresponding rise in temperature of the strip was 0.00066° C.

This temperature sensitiveness is much smaller than has usually been employed in bolometer work, but it was amply sufficient for the purpose. That the bolometer itself was one of high sensitiveness is evident from the fact that this degree of sensitiveness was attained with galvanometer needles swinging in a strengthened field and with a galvanometer of 190 ohms resistance. The conditions for maximum sensitiveness of the bridge would have required a galvanometer resistance of only 0.5 ohms.

The reason for the great sensitiveness lay in the nature of the strips employed. Their area was considerable, the temperature coefficient of the iron was high, and the current through it was large, ranging from 0.15 to 0.20 amperes, the size of the strips permitting the use of a large current without undue heating. As a result of the strong field in which the galvanometer needles swung, the drift due to magnetic changes was usually imperceptible.

The bolometer, compensating resistance, and battery were all placed in an interior room, with thick brick walls, and having communication with the outer room only by a door, *D*, Fig. 3.

The temperature of this room changed very slowly, and it was quite free from draughts. The bolometer box, *B*, was placed upon a shelf fastened to the door of the room, and looked out, through a hole in the door, upon the outer room. A double screen, *S*, of tin, arranged to slide up and down on the outside of this door, covered up the bolometer strips when desired. The box, *B'*, containing the compensating resistance, was also fastened to the inside of the door. The end of the box through which the screw projected, fitted into a hole in the door, so that the screw could be turned and the bridge balanced from the outer room. The wires *g*, *g* led to the galvanometer, and *s*, *s* led to the box which was in multiple with the exposed strip. For further protection from draughts the bolometer box and connecting wires were covered with cotton waste.

Under this arrangement it was necessary to enter the inner room only occasionally to attend to the batteries, and therefore the bolometric resistances were subjected to no sudden changes of temperature. As a consequence, drift due to changes of temperature of these resistances was very small and quite regular. Unfortunately, however, it was necessary to place the box containing the resistance which was in multiple with the exposed strip in the outer room, near the galvanometer telescope. The resistance of this box, and of the wires leading to it, changed slightly with temperature changes in the outer room. As a consequence a slight and regular drift would always ensue upon lighting the gas in the outer room preparatory to beginning work. Since only a very small proportion of the current flowed through this outer circuit, this drift was never large, and would gradually cease as the temperature of the room became constant. Various expedients were adopted for minimizing this temperature change, such as opening a window slightly to admit enough cold air to counterbalance the heating due to the gaslights; closing the valves in the radiator pipes, etc. In every case correction was made for the drift and for any change of sensitiveness which might take place, on the assumption that the change had been a perfectly regular one. Whenever it would seem that this assumption could result in any considerable error, the observations were rejected.

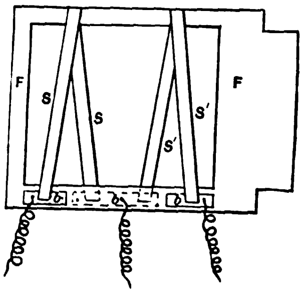

FIG. 3.

In getting the variations of candles, a special device was required to keep the top of the burning candle at constant height in front of the bolometer strip. A suggestion of Mr. C. H. Bierbaum, M. E., resulted in the construction of the following simple and effective arrangement: A spiral spring, about 60 cm. long and 4 cm. in diameter, was attached to a small scale-pan, and the spring was cut off to such a length that when a candle was put on the scale-pan the elongation was just equal to the length of the candle. The spring would then take up as fast as the top of the candle was lowered by burning. A small piece of sheet metal served to protect the spring from the heat of the candle. In order to keep the scale-pan from swinging sidewise and from oscillating up and down, a couple of wires were passed vertically through holes on opposite sides of it, and served as loosely fitting guides, which, without interfering with the take-up of the spring, effectually damped any vibrations. The adjustment of a spring to any candle could be made in a few minutes with sufficient accuracy so that the height of the top of a candle burning on the scale-pan would not vary over 1 mm. in an hour. C, Fig. 3, shows this arrangement in place.

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[1] B. W. Snow, Wied. Ann., Vol. XLVII, p. 213; Phys. Review, Vol. I, p. 2.

[2] F. Paschen, Wied. Ann., Vol. XLVIII, p. 272; Zeitschr. für Instrumentenkunde, Vol. XIII, 1893, p. 13.

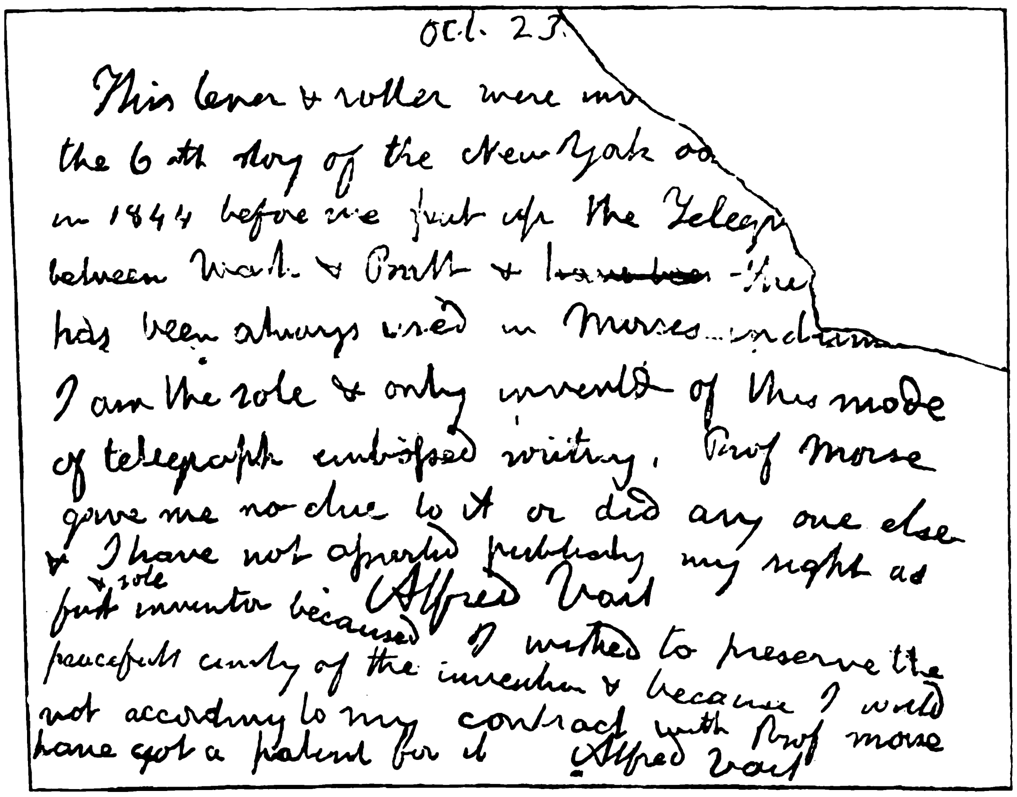
[3] Angström, Oefvers, af kongl. Vetenskaps-Akad. Förhandl., 1893, Vol. VI, p. 379.

(*To be continued.*)

THE DEVELOPMENT OF THE ELECTRIC TELEGRAPH.—V.

BY STEPHEN VAIL.

The statement alluded to in the foregoing paragraph was found, upon the death of Mr. Vail in 1859, attached to the original recording receiver used by him upon the first line, erected in 1844, and read as follows: "This lever and roller were *invented by me* in the sixth story of the New York *Observer* office in 1844, before we put up the telegraph line between Washington and Baltimore, and the *same has always been used in Morse's instrument*. I am the sole and only inventor of this mode of telegraph embossed writing. Professor Morse gave me no clue to it, nor did any one else, and I have not asserted publicly my right as first and sole inventor because *I* wished to preserve the peaceful unity of the invention, and *because I could not, according to my contract with Professor Morse, have got a patent for it*. ALFRED VAIL."



Oct. 23

This lever & roller were in

the 6 th story of the New York Ob

in 1844 before we put up the Telegr

between Wash & Balt & ~~[illegible]~~ - the

has been always used in Morses instru

I am the sole & only inventor of this mode

of telegraph embossed writing. Prof Morse

gave me no clue to it or did any one else

& I have not asserted publicly my right as

first & sole inventor because Alfred Vail I wished to preserve the

peaceful unity of the invention & because I could

not according to my contract with Prof Morse

have got a patent for it Alfred Vail

FAC SIMILE OF VAIL'S MEMORANDUM ATTACHED TO THE ORIGINAL RECORDING RECEIVER.

The last lines of this statement tell the story and disclose the reasons why Alfred Vail's great part in the invention of the electric telegraph is so little known, and why his partner has been enabled to claim as *exclusively his own* that which he did not invent but which he was compelled to call upon Alfred Vail to furnish, and without which the Morse telegraph would have proven a direct failure as a practical commercial invention.

In further support of the claims that I have made, and shall continue to make, for a just recognition by the world of the part my father had in the invention and development of the telegraph, I will, in concluding these communications, cite some evidence additional to that already given here. I desire to have it distinctly understood that neither the family nor the friends of Alfred Vail have the slightest wish or intention to ignore the just claims of Professor Morse nor to deprive his name of *one iota of credit it is entitled to*, but, knowing as we do that he has assumed an exclusive right to all that the world owes the inventor of the telegraph (whoever he may be in reality), and refused during his lifetime (and his family and friends have sustained that refusal since) to acknowledge that others are entitled to a share of the honor, we feel justified in exposing the treatment to which he and they have subjected the friend and copartner to whom he really owed so much of the success the telegraph achieved.

An editorial in the New York *Sun*, by its editor and proprietor, Mr. Moses S. Beach, in the issue for September 25, 1857, entitled "Honor to Whom Honor Is Due," made this statement: ". . . We will mention a few incidents connected with Professor Morse's own experience which we have never seen in print, and which lose none of their interest from the unassuming modesty of the parties referred to. . . . Alfred Vail entered into these experiments with his whole soul, and to him is Professor Morse indebted, quite as much as to his own wit, for his ultimate triumph. *He it was who invented the far-famed alphabet;* and he, too, was the inventor of the instrument which bears Morse's name. But whatever he did or contrived went cheerfully to the great end. Alfred felt rewarded in seeing the gradual accomplishment of the dream." Mr. Beach was a personal friend of Judge Vail, and was present at the first trial of the telegraph on January 11, 1838. *Professor Morse never controverted the above statement.*

In the monthly magazine, *News at Home*, of the year 1869, an article entitled "The First Week of the Telegraph," written by Dr. William P. Vail, an uncle of Alfred Vail, was printed, and contained the following significant allusion to his deceased nephew: "The birth-time and birthplace of the telegraph as a recording instrument of *intelligence*, ... the parties who wrought the rude original plan into working order and gave it efficiency, the man who *invented* the 'Morse alphabet' (so-called), and to whose ingenuity, mechanical skill and tireless perseverance the clock-work of the telegraph is largely due, ... all this is well understood, and for the most part is written down, and the record, some day in the near future, must find its place in history, upon the true principle of *suum cuique*." *This statement was never controverted by Professor Morse.* It is noteworthy that neither the statement of Mr. Beach in the *Sun* nor that made by Dr. Vail, both widely circulated and copied into other journals during Morse's lifetime, was ever called in question by him.

Mr. Francis O. J. Smith, one of the partners in the original telegraph patent of Morse, having as capitalist and business manager a one-fourth interest, stated in a published letter dated March 30, 1872, before Morse's death, that the modified horizontal lever adapted "to emboss the alphabetical characters" was "neither invented nor combined in the telegraph by Professor Morse, but *exclusively* by our associate, Mr. Alfred Vail, although, for reasons that will be satisfactory to most minds, they were never publicly credited to him, but *have been claimed exclusively by Professor Morse as his own invented combination*."

Mr. Frederick Brent Read, of Cincinnati, in a work published in 1873, entitled "Up the Heights of Fame and Fortune," in a biographical sketch of Alfred Vail, stated: "Alfred Vail first produced, in the new instrument, the first *available Morse* machine. He invented the first combination of the horizontal lever motion to actuate a pen or pencil or style, and the entirely new alphabet of dots, spaces and marks which it necessitated. . . . The new machine was Vail's, not Morse's. The claim is clearly made then that Alfred Vail, in the first place, invented an entirely new alphabet; secondly, he invented an entirely new machine in which was the first combination of the horizontal lever motion to actuate a pen or pencil or style, so arranged as to perform the new duties required with precision, simplicity and rapidity; and thirdly, Vail invented, several years afterward (in 1844), the new lever and grooved roller which embossed into paper the whole simple and perfect alphabetic characters which he alone invented."

In the same writer's biographical sketch of Professor Morse, after alluding to his original apparatus as being placed by him "in Mr. Vail's hands for an entire mechanical reconstruction throughout, to speak a language not only wholly unknown to the first machine, but to perform entirely new functions and to produce an entirely new system of signs and letters, which the first, by its structure, was physically incapable of being made to speak," adds with regard to Mr. Vail's subsequent improvement: "His more perfect invention of a steel style upon a lever, which could strike into the paper, as it was drawn onward over a grooved roller, and *emboss* upon it the same alphabetic characters, was not made until 1844, about the time the first line of telegraph began to speak between Baltimore and Washington."

It would seem as if sufficient evidence has been given in this article to convince all fair-minded persons, *who may be susceptible to conviction*, that the name and memory of Alfred Vail have never received, at the hands and pens of those who should know the facts and embody them in their writings, the honor and credit due him for his great part in the invention which they so blindly, or, what is worse, wilfully, ascribe entirely to Morse. I refer to writers upon the subject in alleged histories, scientific publications, newspaper articles and the many other occasions upon which mention is made of the telegraph. As before stated, one writer belittles Alfred Vail's work because "if Morse had not found *him* he would have hit upon some one else!" Adopting the same line of argument, why give Morse any credit, for had he not conceived the idea of the telegraph, in all probability some one else would have done so, and in fact had, some time before Morse.

A scientific journal, of very recent date, alluding to the semi-centennial celebration of the opening of the first line, mentions Alfred Vail but once and then as an "*assistant* to Professor Morse!" It is not strange that a sense of outraged justice, long continued, and during his lifetime by Professor Morse himself, should incite those who know the truth, and are sufficiently interested to make the effort, feel that it is about time that the great want of magnanimity and generosity towards his old friend and "*assistant*" (yes, assistant in the *highest* sense of the word) shown by Professor Morse, should be ventilated, and his own real position and partial claims to being called the inventor of the telegraph placed on view.

For much matter embodied in the foregoing I am indebted to Prof. William B. Taylor, one of the learned and scientific gentlemen forming the staff of the Smithsonian Institution at Washington, D. C., who wrote a very exhaustive treatise, entitled "An Historical Sketch of Henry's Contribution to the Electro-Magnetic Telegraph," which was published in the Smithsonian Annual Report for 1878; to Prof. Franklin L. Pope, who wrote very fully of Alfred Vail's connection with the invention of the telegraph, published in the *Century Magazine* for April, 1888, and to Prof. George H. Stockbridge, who published an article upon the telegraph in the *New England Magazine* March, 1889, all gentlemen of high standing and well known to the scientific world. Comment upon their full belief in these statements concerning Alfred Vail need not be made, and will prove to reasoning minds certainly of as much force as the customary remark of those who in espousing the claims of Morse as the only "inventor" say, "The statements are preposterous and not worth while to notice."

Generalizing denials of everything that calls into question the validity of what is now known to have been Morse's false status before the world, the recipient of honors, attentions and flattery that he knew did not belong to him alone, are not arguments, and the writer has yet to learn of any tangible evidence that can be brought to refute the claims that have been made in these pages, and that are again repeated, that the telegraph of to-day consists *solely* of the work of Joseph Henry and Alfred Vail. If there is such evidence, bring it to the light.

Mankind, like a flock of sheep, follows where it is led, and, unfortunately for the truth of history (and what history is of value but that which is true?) and the cause of justice, in which all *profess* to be interested, the lead in the matter of the real inventors of the telegraph has been a wrong one. Morse is entitled to a share of the whole credit, Henry and Vail to the rest, but to neither should be given all honor at the expense of the others. In a lawsuit tried before Judge Woodbury of the United States Supreme Court and the Hon. Peleg Sprague, Prof. Morse, being examined under oath, was compelled to confess that he "neither discovered electricity, galvanism or electro-magnetism, all having been known before his time; he also acknowledged that he "had not discovered or invented the electro-magnet, nor the circuit of conductors." In fact, on this trial and being on oath, Morse about confessed that really he had not "invented" anything, but had only availed himself of everything.

(*To be continued.*)

SOME FACTS ABOUT POLYPHASE MOTORS.

BY LOUIS BELL, PH.D.*

In connection with the long distance transmission of power, most engineers will, I think, agree with me in the position that alternating current motors of some kind, and of alternating currents preferably the polyphase variety, are almost a necessity. We have been forced to their use by the exigencies of long distance service, which compel either the total abandonment of continuous current or its use under very embarrassing conditions.

There has, however, been a tendency to look upon the polyphase motor as a somewhat undesirable resort to which we have been driven by long distance work. Such indeed was my own belief from *a priori* reasoning, and before I had obtained that practical knowledge of the subject which can only come from personal experience both with the design and application of any class of apparatus. By such experience and by the commercial demands which have been coming in with steadily increasing frequency, I have been forced into taking the position that the polyphase motor is intrinsically preferable to the continuous current motor for a vast majority of all the uses to which such machinery may be applied.

At present, appearances indicate that not only will the polyphase motor displace direct current apparatus for most long distance transmission plants, but will prove a formidable competitor in all applications of motors to industrial purposes, and this although the polyphase apparatus is the growth of only a few years, while the direct current motor is the outcome of more than a decade of experience.

We may then, in instituting a comparison between polyphase and direct current motors, consider the various properties which a good motor of any kind must necessarily have. Mechanically speaking, we would all agree that it should be simple in construction, strong, not liable to frequent or considerable repairs, convenient in form and not excessive in weight. As regards its properties, it should in general run cool, stand over-loading without serious danger, run at a nearly constant speed, or be capable of considerable variation in speed if necessary. It should be capable for certain uses of sudden and violent exertion, and of easily changing its direction of rotation. In a purely electrical way, it should be simple, efficient both at high and low loads, and should not take excessive amounts of current either in starting or in running.

This represents a difficult list of conditions to fulfil with any one motor, but I believe they can be met better by polyphase than by direct current machines. A direct current motor, for instance, of a given construction and reasonable weight, cannot both run at a constant speed independent of load in a particular case and at the same time be capable of running at a wide variety of other speeds. It usually will not stand considerable over-loads without sparking and at the same time give a fair efficiency at low loads; and so one might go on piling up difficulties. The polyphase motor, too, cannot meet all these conditions with equal success, but examining them one by one you will find that on the whole we can obtain very excellent results.

Taking up seriatim the desirable properties which I have enumerated, and applying them to polyphase motors, we find as regards the first count that their construction is singularly free from complexity. They consist in general of two concentric masses of laminations forming respectively the field magnet and armature. The armature is assembled on its shaft much as in direct current machinery, while the field laminations are held together by a clamping spider of very simple construction. The bearings are supported either on end spiders fitted to the field spiders by lathe work only, or on pillow blocks of the ordinary kind. Commutator and commutator connections there are none, nor should there be collecting rings except in rare instances. The armature need be exposed only to low voltages, and should preferably be wound with a comparatively small number of rather massive conductors, united at the ends either by a single plate or by very simple connectors, the latter form being preferable. The field winding is usually in a greater number of coils than is a direct current field winding, but each coil has a comparatively small number of convolutions, making the total winding by no means complicated.

In lieu of the starting rheostat of the direct current motor, we have a starting resistance which should preferably be placed within the armature, and consists of a few zigzags of metal united at one end and connected at the other to three or more contact pieces. A solid collar short-circuiting these contacts and a forked lever to move the collar completes the equipment, as I am accustomed to employ it. Its most noticeable feature is that the revolving armature, the most troublesome and delicate part of a direct current machine, is free from complication, and that it is almost as solid as if it was a solid mass of metal, and scarcely more liable to injury.

This very obvious simplicity of construction and mechanical strength is strong evidence of unusual freedom from repairs, and as a result of experience I have found that the induction motor is singularly free from liability to accidents of every kind. I have never succeeded even by the severest kind of experimental work in burning out a field coil or doing any serious injury whatever to a motor, although I have kept some of them on static torque tests in rapid succession for hours at a time and have held them at rest and poured current through them until the leads burned off, the motor still remaining undamaged. If there is a test of extraordinary severity that I have not applied to induction motors, I have yet to learn of it. These properties are invaluable in commercial work inasmuch as they practicplly remove the danger of crippling the motor even under exceptionally unfavorable conditions.

As regards the convenience of the form of polyphase induction motors, I think an inspection of any of the types which have been brought out will render argument unnecessary.

The magnetic necessities of the case have led all makers of such apparatus in this country and elsewhere to adopt a species of barrel shape as the general outline of the motor, modified only in the proportions of diameter to length and in the adoption of one form or another of bearing. The tendency of this construction is to bring the center of gravity of the machine very low, thus insuring unusual stability and freedom from general vibration. This form, too, enables one to place the motor in almost any position which is convenient in applying it—upside down, as a side bracket, and the like.

The largest installation of induction motors in the world, just put in operation in Columbia, S. C., aggregating over 1,200 H. P., is composed of inverted motors with their bases bolted to the ceiling timbers of the rooms.

As regards weight, the abolition of any sparking limit to the output and the excellent magnetic materials used might naturally be supposed to lead to motors of unusually light weight, and such is in fact the case. Sixty to seventy pounds per horse power in motors of moderate size is a figure easily reached without any sacrifice of efficiency, and if occasion requires, these limits can be passed with great facility, 25 to 30 pounds of material per horse-power being quite attainable in large units while still retaining satisfactory general properties. I must say, however, that for most uses I do not consider extreme lightness either necessary or desirable, although it is important to be able to secure it if necessary. So much for the mechanical character of induction motors.

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*A paper read at the Eleventh General Meeting of the American Institute of Electrical Engineers, Philadelphia, May 18, 1894.

Electrically speaking, the case is just as favorable. Unless forced to a very large output per pound of weight, an induction motor will run quite cool at a heating limit in fact below that of most direct current machines of similar weight and output. This advantage is mainly due to the very substantial character of winding which can be conveniently employed, and to the fact that the winding is distributed so that the losses in the copper are not localized, while the laminated character of the structure facilitates thorough ventilation. This freedom from excessive heating indicates that the polyphase motor can stand considerable overloading without any serious results, and experience has shown this to be the case. The worst that can really happen is that the motor may fall out of synchronism when the load is sufficiently great, thereby blowing the fuses in the primary line. As sparking is obviated in this type of machine, it can readily be rated at such output as will give a proper limit of heating, and this output will in most cases allow from 30 to 60 per cent. of overloading before the machine will drop out of step. A wider range than this can be obtained if desirable, which it is generally not.

The limit of possible overloading fixes in a general way the possible static torque that can be obtained from a given machine, and this is apparently purely a matter of convenience in design, anything that can reasonably be required being quite attainable. There is no special difficulty in arranging polyphase motors for a starting torque four or five times the running torque, although this would be unnecessary except for severe hoisting and tramway work. At running torque the starting current taken may really be no greater than the running current. From this it will readily be seen that a properly planned polyphase motor is capable of very great and violent exertions in a case of necessity. It will even endure complete reversal under full load within ten or fifteen seconds on motors of ordinary sizes, this time being sufficient for the machine to pass from full load in one direction to full load and speed in the other direction. This reversal is, as is well known, accomplished simply by reversing any two of the primary wires, the effect being to rotate the field in the opposite direction from the armature, thus causing an enormous rate of cutting lines of force and consequently immense effort, causing the motor to stop and reverse.

SPEED VARIATION IN POLYPHASE MOTORS.

This subject has been for the most part in a rather hazy condition up to the present time. The induction motor has been generally known as non-synchronous, and such indeed it is. The name, however, has been frequently used in ignorance of the fact that an induction motor always tends towards synchronous running.

Under ordinary conditions the polyphase induction motor can be made to run at nearly constant speed independent of load, resembling in this respect a well designed shunt motor. A variation from no load to full load of 5 to 6 per cent. in speed would represent ordinary good practice either in a shunt motor or a polyphase one, this limit being exceeded only in small motors or types which may be regarded as special. It is by no means difficult, however, so to design a polyphase motor that the speed shall possess very remarkable uniformity. This condition has been valuable in the Columbia plant previously alluded to. In this case tests of 17 motors showed a maximum variation in speed, from an output of 75 H. P. to friction load of the motor, of only 2.2 per cent., individual motors showing slight variations down to 1½ per cent.

The task of these particular motors is driving a cotton mill, hence the necessity for uniform speed. And this uniformity in speed is not greatly affected by variations in voltage, which would be quite sufficient to cause considerable speed variation in a shunt wound motor; in fact the induction motor is remarkably insensitive to moderate variations in voltage unless it is heavily loaded.

This uniformity in speed has frequently been urged as an objection to the induction motor, barring its employment in cases where speed variation is necessary. This point is not well taken.

The induction motor cannot be made successfully to run at reduced speed by varying the primary voltage. Under these circumstances the output of the machine falls off somewhat more rapidly than the square of the voltage, so that only trifling speed variations are possible. It is a fact, not generally known however, that the speed of a polyphase motor can be varied with the same facility and within the same wide range as is possible in the case of a series wound continuous current machine, such as a railway motor. This is accomplished in the induction motor by a rheostat in the secondary circuit, just as it is accomplished in the series motor by a rheostat in the main circuit. Thus equipped the two machines behave almost exactly alike. The speed at constant torque can be made to vary from full speed down to almost no speed, thus simulating the action of the series motor in the closest possible fashion. At any given speed an increase or decrease of the torque will decrease or increase the speed substantially alike in both classes of motors. In both, too, the efficiency is initially similar and falls off in practically the same ratio. A non-inductive resistance is necessary in the case of the polyphase motor, an inductive one throwing the armature current so far out of phase as to interfere with the proper action of the motor.

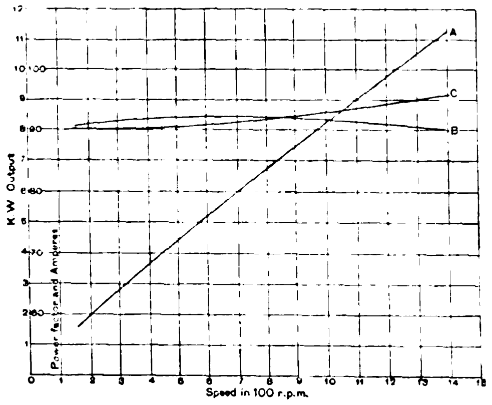

Fig. 1.

Fig. 1 gives an excellent idea of the behavior of a polyphase motor with resistance in the secondary circuit.

Curve A shows the speed and output of a certain motor under these circumstances. It was a four-pole machine operated at 50 cycles per second and the initial speed was reduced to 1,400 by the resistance of the leads reaching across the room to the rheostat composed of loops of manganin strip which would be systematically varied. It will be seen that the word curve is almost a misnomer, the ratio between the speed and output at constant torque being almost a linear function, even when the speed fell to as low as 150 revolutions per minute. It was not carried lower than this only because of lack of adaptability in the rheostat. No series motor could show a more satisfactory result.

Curve B shows the power factor under these varying conditions. It is high at all loads and speeds, varying slightly with a maximum of about half speed.

Curve C shows the variation in current. This, as can be seen, is almost constant, falling off slightly at the lower speeds, the voltage being uniform throughout the test.

Speed variation by this method is not as efficient as might be wished, but still compares favorably with that obtained in a series motor with rheostatic control. Some modified methods of control promising a somewhat better efficiency have been suggested, but it seems probable that in the net result we shall find that continuous current and polyphase motors are about on a par in this respect. It should be noted that in continuous current motors speed variation by weakening the field is only practicable within a very limited range and requires an abnormally heavy motor. I think that with a similar change in design the polyphase motor could be made to operate nearly as well by change in its field strength. An efficient speed variation through a very wide range is attainable in either class of machine only by extraordinary means, as an elaborate combination of direct current machines or frequently changing devices in the polyphase machines. From what has been said it will be apparent that the polyphase motor is perfectly capable of a complete control of speed on the same terms generally obtained with continuous current motors.

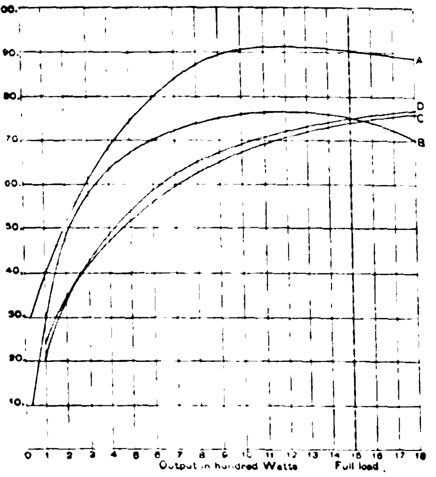

Fig. 2.

COMPARISON OF A POLYPHASE AND CONTINUOUS MOTOR.

Fig. 2 gives a striking comparison between the properties of the two classes of machines under consideration.

The polyphase motor selected for comparison is of 2 H. P. output, representing the average small motor to be found in central station practice. This particular size weighs 218 pounds complete, and runs at a speed of about 1,400 revolutions per minute on 50 cycles loaded. It is relatively neither better nor worse than polyphase motors of other sizes, as may be seen by reference to the curves in my previous paper on this general topic. The power factor in this case rises quite sharply, reaching 86 per cent. at half load and through most of the working range of the motor remains at or near 90 per cent., nearly 91 per cent as a maximum. The efficiency has its maximum a little under full load of the motor and reaches nearly 77 per cent., being 75 per cent. at full load. Both power factor and efficiency hold high values from half load up and do not fall off seriously until some distance below half load.

Contrast with curves A and B belonging to the polyphase motor curves C and D: the former is the efficiency curve of a 2 H. P. 500 volt motor of one of the well known American makes, and curve D is a similar curve for 2 H. P. 110 volt motor of European manufacture. These are not selected curves, but were the two completest available. Both these curves, C and D, show remarkable similarity. Neither of the motors sparked seriously at full load, the load limit being set rather by the heating. Both curves rise slowly and attain their maximum values at some point beyond the available load of the machine. At full load the efficiency is substantially the same as that of the triphase motor. At low loads it is noticeably worse. I think C and D are fair average machines. In tests of a wide variety of motors, some higher and lower efficiencies would be found. Such, too, would be the case in testing a variety of polyphase motors. In fact the mate of the triphase motor shown, sent through the factory at the same time, showed about 1½ per cent. higher efficiency, but a complete test was not attainable as the machine had to be immediately shipped. A comparison of these curves will render it evident that it is quite practicable to produce a polyphase motor having an efficiency fully equal to that of direct current motors of similar size, and I think the tendency will be towards better efficiency at moderate loads. It should be mentioned here that the two horse-power triphase motor was made of ordinary good armature iron, not selected or specially treated in any way.

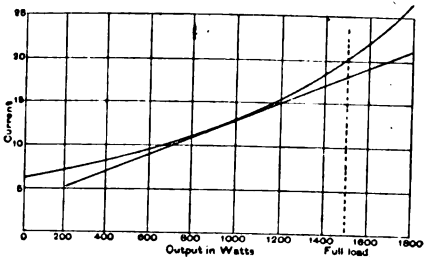

FIG. 3.

Finally, let me call sharp attention to curve 3 which shows the effect of the power factor, which I regret to say has been talked about not wisely but too well in most of the discussions pertaining to polyphase apparatus. The curves in Fig. 3 show the total current in the line in the 2 H. P. triphase motor and the 110 volt continuous current motor above mentioned. The current curve of the continuous current machine is nearly a straight line, that of the polyphase machine is almost tangent to it and slightly concave upwards. A noticeable fact displayed is that throughout the ordinary working range of these two motors the currents were substantially equal, the existence of the power factor in the polyphase motor being only noticeable at very low loads and at overloads. This comparison should be a sufficient answer to the charges of excessive current that have so often been made against the polyphase machines. In a bad polyphase motor they would have foundation in fact. In a rather good one the net effect of the lagging current is trifling. It should further be noted that the current in this triphase motor at friction load is only about 30 per cent. of the current at full load, and of this only 30 per cent. represents loss of energy. This is in marked contrast with the results obtained from a foreign triphase motor of similar size exhibited at the World's Fair, in which the no load current was nearly equal to that at full load and the power factor at full load was barely over 50 per cent.

In this brief discussion of some of the properties of modern polyphase motors I have endeavored to show how nearly they fulfil the conditions which may be regarded as desirable in electric motors in general. That they do as well, if not better, than the continuous current machines of similar capacity I believe that I have satisfactorily shown. The demand which certainly is arising for polyphase motors for general power purposes, based on their intrinsic merits, indicates that the older type of machinery has found a dangerous rival, all questions of long distance transmission aside.

Recollections of Werner Von Siemens.[*]

XI.—Scientific Writings.

As regards the formation of the earth's surface the local elevations, the formation of the stratified diluvium covering almost the whole surface, earthquakes and volcanoes, have also a special interest for the non-geologist. I have tried to give an explanation of these facts resting on a physico-mechanical basis, which satisfies my own desire to get at the cause of things, but which frequently runs counter to the traditional geological views, and therefore has remained almost unnoticed. Of these traditional views I am compelled to declare untenable the one underlying all the rest, that there has been a period when the earth was in a molten state and surrounded by an atmosphere which contained the permanent gases and all the water in the form of glowing vapor. The reasons which influence me will become clear, if we go a step further back to the period when the terrestrial mass assumed the globular form. Its elements must then have been uniformly commingled, and thus been condensed into a magma by mutual attraction in the gaseous state. A segregation of the more volatile bodies could only occur at the point of solidification, when the gaseous state passed into the fluid and solid. A separation of the more volatile bodies in the gaseous state could then take place according to the progress of this solidifying zone. This separation from the molten interior could however only proceed very slowly, as interior specific gravity was the only existing force which could drive to the periphery conglomerations of specifically lighter masses. How great such a difference of density is in the earth's interior cannot be determined, since our knowledge of the behavior of bodies subjected to such high temperatures and pressure as prevail in the interior of the earth is still too slight. It appears however clear that the segregation of our atmosphere and our seas from the terrestrial mass was the work of many geological periods and is not yet completed, as the still active geysers and hot springs testify. We shall be compelled to assume a "Geyser period" as a special geological period, which followed the formation of the solid crust, and in which volcanoes and geysers ejected at innumerable places of the solidified surface the specifically lighter masses, especially water and air, and with the help of the varying currents of the sea formed by them deposited the stratified sediments. The assumption too of the upheaval of mountains by internal pressure does not agree with the assumption of a molten or gaseous interior on which the solid crust floats. They can only be tangential forces which have elevated mountains, and are still elevating parts of the earth's surface. These tangential forces are supplied by progressive cooling of the interior, since the vault formed by the solid covering of the earth would collapse through gravitation if the vanished fluid interior no longer sufficiently supported it. The phenomenon of volcanic eruptions does not necessitate the hypothesis of an internal pressure which is stronger than corresponds to the weight of the solid crust. When we consider that the more recently cooled layers of solid rock must, with progressive refrigeration, be liable to rents, which we feel at the surface as earthquakes, it is clear that such rents may affect also the contiguous cooler crust, already frequently ruptured in former geological periods, and thereby bring about direct communications between the fluid interior and the surface. The still fluid terrestrial mass must then penetrate into these cracks, and as it is hot and therefore lighter than the superincumbent rock, it must burst forth and form a mountain, with a height corresponding to the difference of the specific gravity. As with the diminution of the pressure exerted on the hot fluid ascending in the fissures, the gases and vapors contained in the magma must be set free, the bubbles of gas in the column of fluid rock will still further considerably diminish its specific gravity, and the height to which the fluid interior is raised in volcanoes is thereby explained without the necessity of assuming a mysterious pressure in the interior overbalancing the hydraulic force.

It is surprising that professional geologists have left these views, modifying in such essential points the foundations of their traditional doctrines, unnoticed and unrefuted for more than a decennium.

In an essay "On the luminosity of flame" I described a series of experiments on the problem of the radiation of light of gaseous bodies, which I partly instituted in the large glass furnaces, provided with regenerative heating, of my brother Frederick in Dresden and in conjunction with him. It appeared from these experiments that permanent gases, if entirely free of dust, are not luminous even at a very high temperature. As they at the same time possess a remarkable power of radiating heat, it is doubtless to be assumed that with further increase of heat they must nevertheless at last begin to be luminous, because rays of light and heat are only distinguished from one another by the greater number of vibrations of the former, and because the radiating power in general seems to decrease with the number of vibrations. At any rate the power of radiating light appertaining to dust-free pure gases is so exceedingly small that the luminosity of flame must be specifically different from the luminosity of the gases heated by the process of combustion. Apart from the the luminosity of the solid particles separated by combustion or suspended as impurities in the gas, the luminosity of flame can only be an electrical process, which is connected with the chemically shifted position of the molecules of the burnt gases. The light of flame would according to that be just as much electric light as the light of the ozone tube or of the Geissler tube.

The interesting controversy, in which my deceased brother William became involved with the astronomers through his work "On the conservation of the solar energy," led me also to the sun and occasioned my paper "On the admissibility of the assumption of an electrical solar potential and its importance for the explanation of terrestrial phenomena." As the known ways of producing electrical phenomena always depend on a separation of positive and negative electricity, we must assume that this holds good for the sun also, that therefore an electrical solar potential can only exist if the one electricity is carried away from the sun. The theory set up by my brother, that solar matter is flung off and diffused in the universe in consequence of the sun's rotation, makes therefore the supposition of a solar potential admissible. The objection of the astronomers that interplanetary space cannot contain the smallest quantity of matter, because then the period of the planets would be increased, I sought to refute by the consideration that the matter itself, expelled from the sun, must rotate round the sun with planetary velocity, that it could not therefore impede the course of the planets. I also supported my brother's view that the solar light arises from the burning solar mass in its ascension, although I could only to a certain extent assent to his view that the combustible atmosphere resting on a fluid or solid solar surface, which is flung off in the burnt state and then again dissociated by the sunlight in space, and in this state again attracted by the sun, was the cause of the solar rays. I could only assent to it so far as the participation of the whole gaseous mass of the sun in the combustion was concerned, and could assign to the flung-off mass only a secondary importance in the thermal economy of the sun, but on the other hand considered it decisive as regards the question of its electrical charge.

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[*] Selected from "Personal Recollections of Werner Von Siemens," recently published in America by D. Appleton & Company, New York, 416 pp., 12mo, uncut edges, wide margin, photogravure portrait.

Ritter's admirable and still insufficiently appreciated works remove all doubts as to the sun's gaseous state, with which the existence of a special solar atmosphere is incompatible. We must therefore assume that the whole solar mass is undergoing a continuous process of combustion, but which can only actually take place in the outermost layer of the body of the sun, where the solar gas is already so far cooled by expansion that chemical combinations can be formed. These then occur with formation of flame and enhanced temperature at the whole solar surface, whilst a flinging off, such as my brother assumes, can only be possible in the equatorial zone in a very limited degree. A general descent of the burnt mass cooled by radiation must follow the general ascent of the uppermost layers of the sun, in consequence of their combustion and heating beyond the diabatic temperature corresponding to their expansion. This takes place in innumerable descending streams, which give to the solar surface its scaly appearance, or in the mean solar latitudes also assumes the form of colossal descending vortices, which are darker than the rest of the solar surface since the descending products of combustion indeed nearly recover, by their compression, the temperature which they possessed at the beginning of the ascent, but are thereby also dissociated and correspondingly cooled. For this reason and on account of the absence of flame these descending vortices appear as dark sun-spots. Certainly this combustion theory is still opposed by the circumstance that the existence of oxygen in the sun has hitherto been spectroscopically proved only at the bottom of the sun-spot funnel; but the greatest argument for it is, that the sun possesses a composition essentially the same as the earth, that therefore oxygen cannot be wanting.

I have tried to support this solar theory, which admits the origin and preservation of an electrical solar potential, by the proof that the latter would explain many hitherto unexplained terrestrial phenomena. With the colossal dimensions of the sun in comparison with those of the earth the sun's potential will call forth by electric distribution a terrestrial potential of nearly half the amount, if we assume that the electricity, becoming free at the earth's surface, and similar to the solar electricity, is absorbed through radiation and neutralization by the electricity of the oppositely electrified matter, proceeding according to brother William's theory from the sun in the direction of the sun's equator. That this high electric tension is not observed at the earth's surface is a consequence of the size of the earth's radius. Now by the rotation of the earth the electricity bound to the earth's surface by the solar electricity is carried round the earth, and thus produces the effect of an electric current circling round it, which makes it magnetic. Just as the earth's magnetism, so also the terrestrial currents and polar lights find their explanation by the electrical solar potential, and similarly the reaction of phenomena in the sun, such as the occurrence of sun-spots and coronæ, on terrestrial phenomena becomes explicable, if we conceive them intimately connected with changes of the sun's potential. Atmospheric and lightning electricity likewise find their explanation through the electrical solar potential.

(*To be continued.*)

Personal.

Messrs. Alexander Siemens, of London, and Arnold von Siemens and Count Schliffenbach, of Berlin, are at the Plaza Hotel.

Mr. J. H. Rhotehamel, president of the Columbia Lamp Company, was in New York a few days this week, and is now at Atlantic City.

General News.

What is Going on in the Electrical World.

Fort Dodge, Iowa.—The electric light franchise granted to S. T. Meservey by the council has been ratified by a vote of the citizens at a special election.

Oshkosh, Wis.—J. K. Tillotson has filed his bond for the construction of the electric street railway. His bondsmen are ex-Senator Stephen W. Dorsey and Jesse M. Thompson of Chicago.

Pine Grove, Pa.—The borough of Tremont has granted the right of way to the Pine Grove and Tremont Electric Light, Heat and Power Company, who will place a number of arc lights in that town.

Brooklyn, N. Y.—The State Railroad Commission has granted permission to the Coney Island and Brooklyn Railroad Company to change its motive power from horses to the overhead trolley system.

Key West, Fla.—A franchise has been granted to Messrs. Philbrick, Allen and others for an electric street car system for Key West. The present street railroad company also intend to change the motive power of their line to electricity.

Toronto, Can.—The Industrial Fair to be opened here about the first of September will, it is said, surpass any annual exposition hitherto held in Canada. Many new electrical features will be introduced. Entries close on the 11th of August.

Spokane, Wash.—Freight cars are now run by electricity between the flour mills and the railway elevators in parts of this city. The type of car used is 20 feet long, 6 feet wide and 5½ feet high, so that externally the appearance is that of a short box car.

Hartford, Conn.—The Perkins Electric Switch Manufacturing Company is about to add 15,000 feet of floor space to its manufactory on Woodbine street. In addition to electric switches, the company now manufactures arc lamps, sockets and several electric specialties.

Hartwell, Ohio.—A stock company, with a capital of $20,000, is to be formed in Hartwell for the purpose of supplying electricity for street and commercial lighting. R. S. Waddell, who is mayor of the village, is at the head of the enterprise and speaks in sanguine terms of the outlook.

St. Paul, Minn.—The delegates to the Northwestern Electrical Association's midsummer meeting were treated to an excursion to Minnehaha Falls by the Electrical Engineering Company of Minneapolis. They expressed themselves as delighted with their experiences in the twin cities.

Syracuse, N. Y.—The Syracuse Electric Railway Company has purchased a lot between Tracy street and the canal as a site for a power house. The new building will be of brick, 120 x 150 feet in dimensions, and the electricity with which to operate all the company's lines will be generated there.

Wakefield, Mass.—At a special town meeting in Wakefield, last week, the town voted to issue bonds in the sum of $180,000 for the payment of the Citizens' gas and electric plant. The town pays $144,000 for the plant, and $36,000 is for enlarging the plant and for other needed improvements.

Boston, Mass.—An electric lighting and power plant is to be put in at the navy yard. The work upon the plant will begin early in August. It is proposed to utilize a portion of the great machine shop for a power station, and in addition to the apparatus for illuminating an electric-welding machine will be set up.

Woodbury, N. J.—A new electric light company has been formed here composed of prominent citizens. If the city council grants the company a franchise a plant will be put in at once. The main object of the company, it is said, will be to furnish light to residents at a lower figure than they are at present paying.

Grand Haven, Mich.—An electric railway between Spring Lake, Grand Haven and Highland Park has been discussed for several years and is now to become a fact under the management of a Chicago company, which proposes to run the plant by water power, utilizing Crockery Creek, a large stream flowing into Grand River six miles east of Spring Lake.

Niagara Falls.—The officials of the Cataract Construction Company have been notified that the first of the three enormous dynamos—each 5,000 H. P.—building for the company at the Westinghouse shops at Pittsburg, will be soon ready for shipment. The turbines and shafting for operating the dynamos will be in place by the latter part of the present month.

Pottsville, Pa.—Surveyors have lately been at work mapping a route for the Pottsville, St. Clair and Minersville Electric Railway, and work will begin on the road as soon as the right of way is granted by the borough council. The road is to be ten miles in length. The capital of the company, of which Wilber S. Sadler, of Carlisle, Pa., is president, is $150,000.

Providence, R. I.—The villages of Jericho and River Point celebrated the opening to the public of the Pawtuxet Valley Electric Railway with a regular Fourth of July kind of enthusiasm. There were military parades and civic processions, addresses, cannonading, brass bands, picnics, fireworks and many other festivities, and 20,000 people from all over Rhode Island assembled to do honor to the occasion.

Heart's Content, N. F.—The laying of the new cable of the Anglo American Telegraph Company, the largest cable across the Atlantic, was completed on the 27th ult. The time taken in laying the cable was less than fourteen days, two steamships, the Britannia and Scotia, being engaged in the operation. They met in mid-ocean where a splice was made and each started in an opposite direction, one heading towards Valentia, Ireland, and the other towards Heart's Content.

Washington, D. C.—The House Committee on Judiciary have reported adversely the bill of Mr. Catchings, of Mississippi, to incorporate the National Rapid Transit Company. The company requesting the charter proposed to connect New York and Washington by an electric railway by which a speed of 120 miles or more could be maintained. —A bill to authorize one of the street car systems in this city to extend its lines and change its motive power has passed both branches of Congress. It requires the company to equip and operate its lines with an underground electric system within a period of two years, under heavy penalties for failure.—The House has passed by unanimous consent and without discussion the bill granting right of way through the Arlington reservation for the Washington, Alexandria and Mt. Vernon Railway.

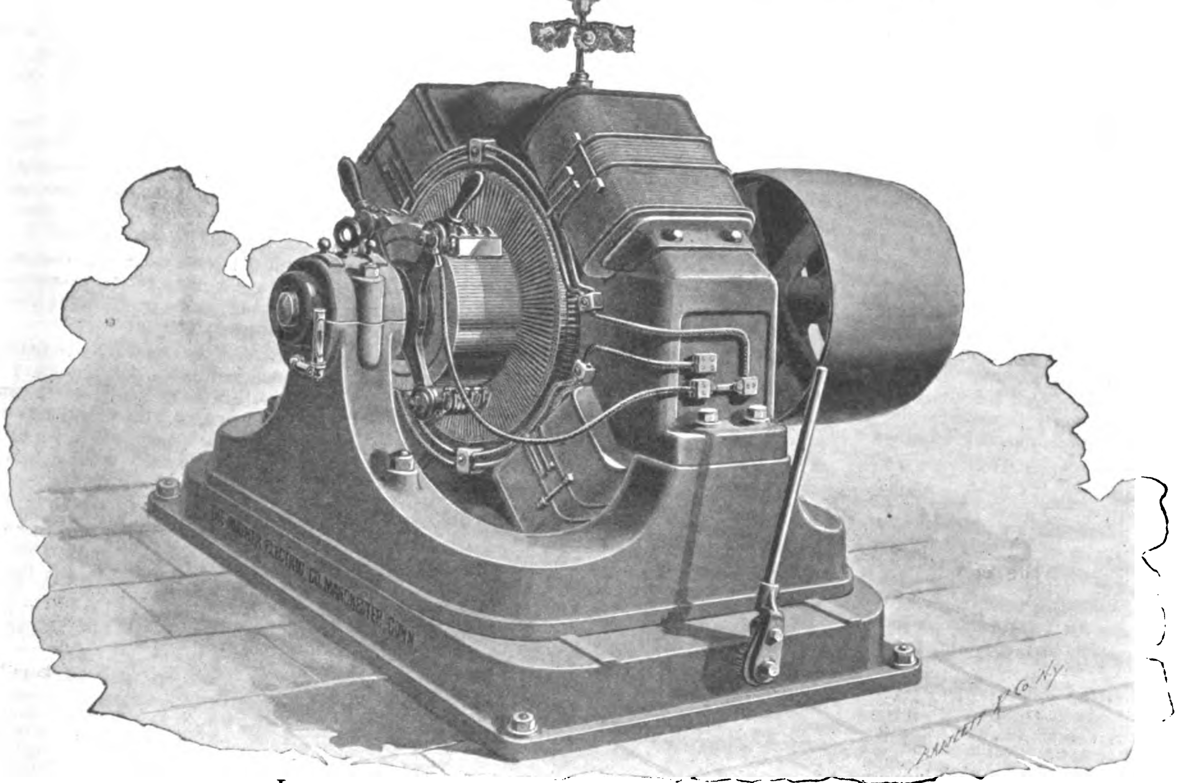
Buffalo, N. Y.—The *Express* states that "it is expected now that the contract for building the pole line for transmission of electric power from the Niagara Falls Power Company's station to Buffalo will be let within the next ten days. The insulation will be on the same general plan as the Tivoli-Rome circuit of twenty miles with a current of 5,000 voltage only. These lines are for 10,000 voltage, and with the improvements made in the past three years a higher efficiency is expected with the greater current than with the 5,000 voltage current in the Tivoli-Rome circuit. The copper cables to be used are six-tenths of an inch in diameter and are to be strung twenty-five feet above ground on steel poles, imbedded in concrete. Should, by any chance, one of these cables break, an automatic arrangement will be provided that kills the current the moment the wire touches the ground, but the exceptional care taken in building the line will render the breakages almost impossible. Power will be given to Buffalo early in October, according to present figuring."

Randallstown, Md.—The proposed electric railway between Pikesville and Randallstown will be operated by the Barrows system if negotiations for a transfer of the right, title and interest of the Randallstown, Harrisonville and Granite Rapid Transit Company in the project are successful. In the proposed system the cars are run on a kind of trestle work, the level of the track being maintained by longer or shorter posts. Only one rail is used. This will carry the electric current and support the weight of the car. Longitudinal girders on each side of the rail will be used as wheel bearings for the broad-faced flangeless side wheels of the car. These wheels on the cap of the girders, and the double-flanged centre wheels on the rail, bite the track with a grip that prevents the possibility of slipping, making every revolution count. In case of derailment, the cars will slide on the girders and rail in safety until stopped by loss of momentum. The cars may be operated by either storage or trolley system.

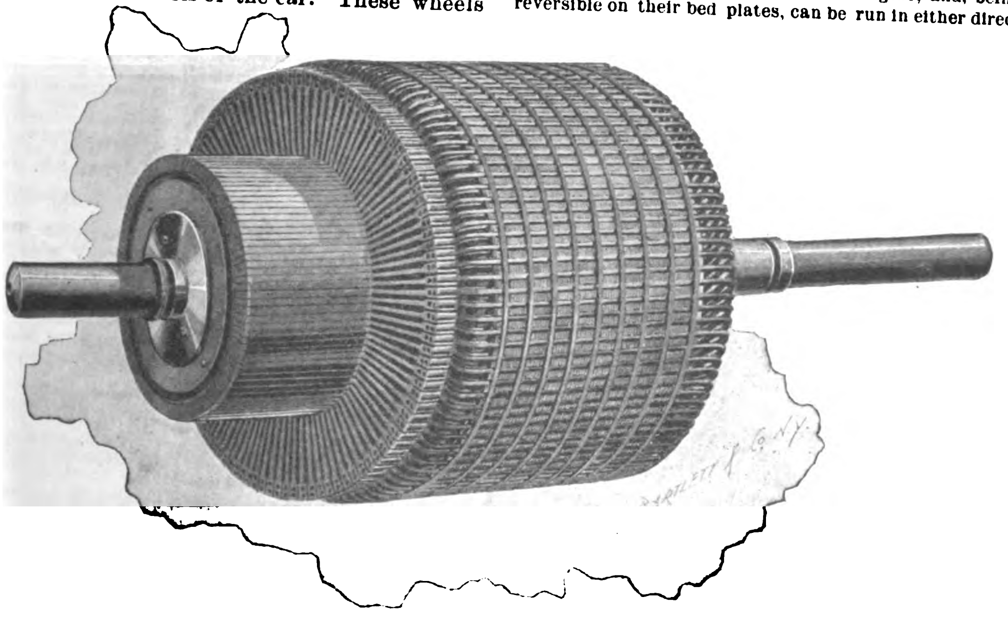
The Mather Electric Company's Standard Electrical Apparatus.

The Generators manufactured by the Mather Electric Company at Manchester, Conn., are the result of years of experience and the most advanced ideas in the design and construction of this class of apparatus. In these Generators, on account of their peculiar design and construction, results have been accomplished in efficiency, durability and regulation under extreme changes of load which the company assert have never been possible to attain before in any type of generator, thus easily giving these machines the preference to any other design on the market. They are constructed upon thoroughly scientific principles and are theoretically perfect in their design, resulting in exceedingly high electrical efficiency. One peculiar advantage of this type of Generator over others is that on account of the fields being cast in four pieces, and entirely separate from the frame, all being bolted together, the assembling or taking apart of the Generator to allow the removal of the armature is accomplished in an exceedingly short time and with the greatest ease. These Generators are designed to be belt-driven or direct-connected to the shaft of the engine, and, being reversible on their bed plates, can be run in either direction at will by making a slight change in the connections. They are self-oiling, self-exciting, perfectly self-regulating, and after being started, completely self-attendant. The company's Multipolar Generators are all compound wound and entirely self-regulating, and equally well adapted for electric lighting, electric railway, or power purposes; they are all standard machines and any part can be duplicated at once. Their Railway Generators are wound for a nominal voltage of 500, but, having a rheostat in the field circuit, the potential can be raised to 600 volts without undue heating, and even 50 per cent. overloads will be borne for short periods without injury to the machine.

A common difficulty with Generators is sparking at the brushes, which is usually caused by the points of commutation shifting with variations in the load. This difficulty has been overcome in the Mather Generators, for it has been proved that after the brushes have once been adjusted further change is not necessary, no matter how sudden may be the variations in the amount of current supplied by the Generator. No sparking is caused even by a current in excess of the rated capacity of the machine, and it is impossible to distinguish by watching the brushes whether the Generator is loaded or not. The Generators can be operated for an indefinite period at their full rated capacity without any undue or dangerous heating of any parts.


THE MATHER ELECTRIC CO. MANCHESTER, CONN.
Bartlett & Co. N.Y.

Improved Mather Multipolar Generator, 250 H. P.


Bartlett & Co. N.Y.

Armature, Mather 250 H. P. Generator.

Automatic alignment is secured by the use of ball bearings, which adjust themselves and can never bind on the shaft. The supports for the bearings and the entire bed plate are cast in one piece a construction which gives great strength and rigidity to the bearings, and secures the greatest possible freedom from vibration.

There are four sets of brushes used on the Generators. Each brush is held in an independent holder, hence any single brush can be raised from the Commutator without disturbing the others, and each having its own spring may be perfectly adjusted. The diametrically opposite brushes are of the same polarity and are connected. The rocker arm of the brush holder is of rigid construction and the different parts are perfectly insulated; it is designed so that it will adjust all the brushes simultaneously.

One of the distinctive features of these Generators is the construction of the Armature, which is of an improved type. The core is built up with thin disks of soft iron which are forced together under pressure and rigidly keyed to the shaft. All washers used in the construction of the Armatures are first treated to an improved annealing process employed, with the result that the armature when revolving in the most intense magnetic field will only heat up to a few degrees above the surrounding temperature. The greatest care is taken in the insulation of these Armatures. Before winding, there is fitted into each slot a carefully made mica duct, through which the wire is wound, and nothing but the very best mica and insulating material is used throughout the whole construction. The winding is of the simplest form possible, which is particularly noticeable at the end of the Armature, where the wires, instead of being overlapped and bunched together, stand out from the core and from each other, thus allowing free circulation of air around every conductor. No wires having a large difference of potential are adjacent to one another.

The small amount of wire on these Armatures accounts in great measure for the absence of sparking at the brushes, and the fixed position for the points of commutation under variations of load. No matter how great the current in the Armature conductors, the field is always powerful enough to overcome the effect of their cross-induction, and consequently the lead does not have to be changed.

The field consists of four steel castings, which are rigidly bolted together, and which, in turn, are bolted to the cast-iron frame or bed-plate. The exciting coils are compound wound on metal bobbins, which can be readily slipped on or off by loosening a few bolts and raising one of the field castings.

Most careful attention is given to proportioning the winding of the Generators, and they are so compounded that as the current supplied to the circuit increases the voltage rises sufficiently to make up for the loss of drop in the circuit or for a variation in the speed. This action insures an almost uniform voltage at the terminals.

A feature of the utmost value peculiar to the company's Multipolar Generators is the employment of cast steel in the fields, which greatly increases the efficiency of the Generator, giving an extremely powerful magnetic field, nearly double that possible where cast iron is used or which can be obtained with laminated soft iron pole pieces cast into the yoke, or frame, of the machine, on account of it being almost an utter impossibility to do this without producing blow holes or large apertures in the field casting, back of the laminated pieces. The advantages of this design and the use of cast steel in the fields, in the operation of the Generators, are manifold, but perhaps the most important lies in the fact that the motion of the Armature is practically powerless to disturb the lead, and consequently the machine may be operated under full load within the limit of its capacity, and even under a load considerably exceeding its normal capacity, without shifting the brushes and without sparking at the Commutator. The great practical value of this characteristic will be understood by all who are familiar with the action of direct current machinery.

In their Commutators, the company use the very best drop-forged Lake copper bars. Great care is taken in the insulation, nothing but the very best mica being used. Owing to their peculiar construction, it is an impossibility for any bars to work loose while the Commutator is on the shaft.

The Mather Company are prepared to furnish complete station equipments of their own manufacture, including some ingenious and useful novelties. Their new catalogue is in press and will be issued in a few days.

The Correspondence School of Mechanics and Industrial Sciences.

The Correspondence School of Mechanics and Industrial Sciences conducted by the Colliery Engineer Co. at Scranton is in a flourishing condition, over 4,000 students now being enrolled in the above and the Correspondence School of Mines.

The following are a few of the many testimonials received from students :

MUDDY VALLEY, Ill., Nov. 28, 1893.

GENTLEMEN : Since enrolling as a student in your school I have learned ventilation, methods of working, mine surveying and mine mechanics. The Instruction Papers are so plain that students cannot help but learn. I passed the State examination for mine managers eight months after taking the first lesson. Yours truly,

W. D. BRIGHAM.

LYONS, Kan., Nov. 23, 1893.

GENTLEMEN : Your School of Mines course is far more voluminous and thorough than I supposed it to be. I have found it to be of great practical value, and heartily commend it to any one who contemplates taking up the study of mining engineering. Yours truly,

J. AINSWORTH,
Sup't Lyons Rock Salt Co.

WILKESBARRE, Pa., Nov. 11, 1893.

GENTLEMEN : Your method of instruction is an excellent one. Any one who will apply himself to study, no matter how dull he is, cannot fail to understand the Instruction Papers. By studying during his leisure hours he can qualify himself for any position connected with mining that requires skill and training. Your tuition fees are very moderate when the amount of time and labor taken in teaching each student is considered. I am very well pleased with the progress I have made and the pains you have taken to instruct me. I heartily recommend the school. Truly yours,

HARVEY FAULDS.

The course includes practical instruction in electrics, and could not fail to be of immense benefit to large numbers who have not had the opportunity of early study.

COMMERCIAL PARAGRAPHS.

Mr. Geo. L. Colgate, 136 Liberty street, New York, selling agent for several lines of specialties, favors us with the latest catalogue of the Whitney Electrical Instrument Company, of Boston.

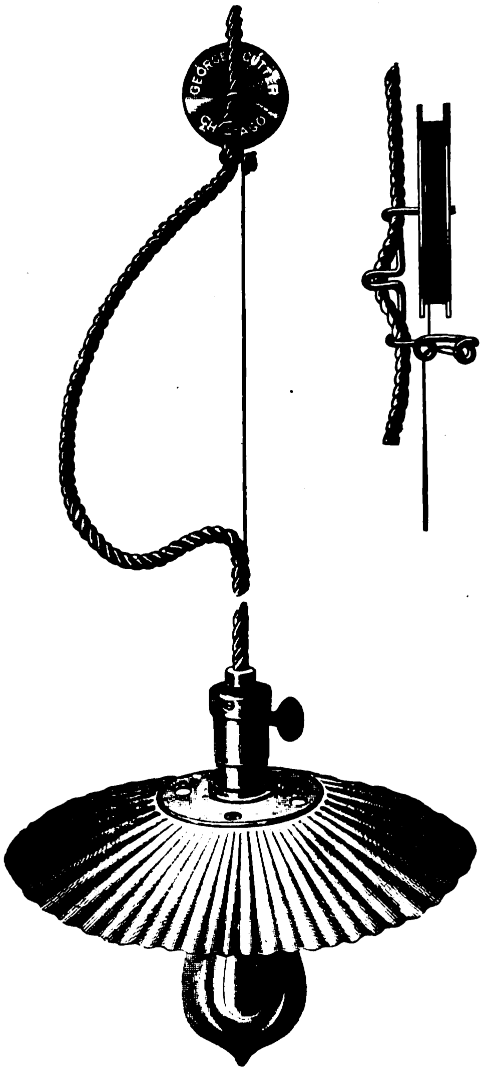
Mr. B J. Arnold, consulting engineer, has removed his offices to rooms 574-576 The Rookery, Chicago.

The Columbia Electric Company of Worcester, Mass., are doing a flourishing business with first-class prospects for the fall campaign.

The United Electric Corporation of Minneapolis, incorporated under the laws of Minnesota, propose to manufacture and deal in all kinds of electrical machinery, but for the present will confine their operations to telephones and telephone supplies. Mr. Grant, the president of the company, is a prominent capitalist in the Northwest, and under his guidance the company starts out with favorable prospects.

Cutter's Cord Adjuster.

This new arrival among the automatic devices for adjusting the height of drop lights is said to be the simplest and neatest of them all. It certainly is small and compact, being only twice the size shown in our smaller cut, and the ingenious arrangement of the fastening allows it to be put in place in half a minute without the use of tools. There is no need of disconnecting the cord from the rosette or socket, nor for coiling up the lamp-cord, as is the case with the older forms. Still it takes up enough slack in the cord to meet the common requirements, and holds the lamp and shade securely at any point within its range.



CUTTER'S CORD ADJUSTER.

In short, it seems to be just the article that has been wanted for general use, and the maker (George Cutter, of Chicago,) has reason to count on a large trade for this ingenious little device.

INCORPORATIONS.

The Southwestern Telegraph and Telephone Company has filed with the Secretary of State at Albany, N. Y., a certificate of an increase of its capital stock from $2,000,000 to $3,000,000. The debts of the company amount to $280,106.

At Springfield, Ill., on the 28th ult., the Secretary of State licensed the Harrison Telephone Company of Chicago, with a capital stock of $4,000,000. The incorporators are Thomas Whitney, M. A. Ree and G. R. H. Hughes.

The Vanderwerken, Rickerson and Brainerd Company—to do a general mercantile and manufacturing business and to manufacture electrical apparatus in New York City and Brooklyn. Capital stock, $20,000. Directors: Alfred Vanderwerken, Chas. L. Rickerton and Harry J. Brainerd.

The Scenic Electrical Amusement Company, Jersey City—to manufacture scenic electric theatres. Capital stock, $2,500. Incorporators: John A. Seeley, Philip J. Bennett, W. H. Grady and Ferdinand W. Roebling.

The Electric Light, Power and Water Power Company, Sea Isle City, N. J.—to construct and maintain electric, water and other plants at Sea Isle City. Capital stock, $50,000. Incorporators: Morris Boney, James A. McCullough, James McGuinness, James Conway, all of Philadelphia, and John Haugh, of Sea Isle City.

Articles of incorporation of the Harrison Inter-State Telephone and Telegraph Company were filed in the clerk's office at Frederick, Md., on the 21st inst. The corporation is formed for the purpose of building, owning, manufacturing, buying, selling, constructing and operating telephone and telegraph lines, and for manufacturing, buying and selling telephones and telegraph supplies of all descriptions and doing a general electric business. Its operations are to be carried on in the State of Maryland and adjoining States and the principal office of the company is to be in Frederick. Capital stock, $25,000. Incorporators: Dr. Peter D. Fahrney, John Baumgardner, James E. Walker, Francis B. Sappington and Edgar L. Miller—all well-known citizens of Frederick.

The F. D. Potter Company—to carry on the business of consulting engineers and to deal in electrical apparatus and machinery. Capital, $1.000. Directors: David W. Potter, of Waldboro, Me.; William J. Newton and Joseph Hutchinson, of New York City.

Pitcairn, Wilmerding and Braddock Street Railway Company—to build an electric line three and a half miles long in Braddock and Versailles townships, Pa. Capital stock, $21,000. Directors: W. J. Kline and Amos B. Kline, Greensburg; John S. Stewart, North Versailles township; George W. Borrichlow, George C. Garber and H. L. Castle, Pittsburg.

The O'Fallon Electric Light, Power, Heat and Water Company, O'Fallon, Ill. Capital stock, $20,000. Incorporators: S. C. Smiley, E. Tiedeman, Philip Hehde and Joseph Porter.

Pontiac Telephone Company, Pontiac, Ill. Capital stock, $3,000. Incorporators: D. S. Myers, John S. Murphy, Henry A. Foster, M. H. Greenbaum and Z. E. Vost.

The Arnold Telephone Company, at Chicago. Capital stock, $1,000. Incorporators: Samuel G. Arnold, Benjamin F. March and William Howell.

The Columbia Engraving Company, Chicago, certified to a change of name to the Columbian Engraving and Electrotyping Company, also an increase in capital stock from $10,000 to $25,000.

The Yonkers Electric Railway Company—to construct a surface railroad in Yonkers, N. Y., about ten miles long, to be operated by any power other than steam. Capital stock, $1,000,000. Directors: J. Irving Burns, W. Delevan Baldwin, Gelston Affleck, all of Yonkers; B. L. Rice, Charles J. Downing, both of New York City; George S. Forbush, of Brookline, Mass.; George W. Williams, of Bandon, Oregon; W. R. Hurd, of Hartford, and D. Noble Rowan, of Irvington.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JULY 24, 1894

ELECTRIC RAILROADS AND APPLIANCES.

523,396. Electric-Railway System. Albert C. Crehore, Ithaca, N. Y. Filed July 20, 1893.

523,625. Trolley-Catcher. Edwin M. Drummond, Louisville, Ky., assignor of one-half to Joseph O. Haddox, same place. Filed March 3, 1894.

ELECTRIC LIGHTS AND APPLIANCES.

523,395. Multiple Filament Lamp. Albert L. Clough, Manchester, N. H., assignor of one-half to Walter G. Chase, Boston, Mass. Filed Aug 2, 1893.

523.401. Method of Working Arc Lamps. William S. Horry, New York, N. Y., assignor of one-half to Walter F. Smith, Philadelphia, Pa. Filed Oct. 17, 1893.

523,460. Incandescent Electric Lamp. Francis M. F. Cazin, Hoboken, N. J. Filed Dec. 7, 1892.

523,461. Electric Incandescent Lamp. Francis M. F. Cazin, Hoboken, N. J. Filed July 24, 1893.

523,482. Adjustable Incandescent-Lampholder. Samuel E Nutting, Chicago, Ill. Filed Aug. 17, 1893.

MOTORS, DYNAMOS, ETC.

523,444. Controlling Mechanism for Electric Motors. Chas. H. Richardson, Philadelphia, Pa., assignor to the S. S. White Dental Manufacturing Company, same place Filed April 26, 1894.

523,453. Mode of Mounting Dynamos on Car-Trucks. William Biddle, Brooklyn, assignor to the American Railway Electric Light Company, New York, N.Y. Filed Oct. 6, 1893.

523,572. Electrical Converter. Robert H. Hassler, Dayton, Ohio. Filed Aug. 4, 1893.

523,586. Starting and Controlling Device for Electric Motors Joseph W. Moore, Boston, Mass. Filed April 25, 1894.

523,429. Power-Transmitter. John A. Johnson, Chicago, Ill. Filed June 6, 1893.

TELEPHONE AND TELEGRAPH APPARATUS.

523,613. Telephone-Switch. Jacob O. Zeigler, Boston, Mass., assignor of one-half to Alfred A. Ziegler, same place. Filed May 10, 1894.

523,617. Signal-Telegraph. Claudius V. Boughton, Buffalo, N. Y., assignor to the Boughton Telephotos Company, same place. Filed Nov. 13, 1893.

523,630. Telephone. Stephen D. Field, Stockbridge, assignor to the American Bell Telephone Company, Boston, Mass. Filed April 7, 1894.

BATTERIES.

523.571. Secondary Battery. Antoine E. Peyrusson, Limoges, France. Filed Nov. 1, 1893.

MISCELLANEOUS.

523,354. Electrically-Propelled Perambulator. Emil E. Keller, Chicago, Ill. Filed April 20, 1892.

523,369. Electrical Igniting Device for Gas-Engines. Alonzo J. Painter, Pasadena, Cal.. Nannie Painter, administratrix of Alonzo J. Painter, deceased. Filed July 28, 1893.

523,471. Electric Snow Plow. Louis J. Hirt, Somerville, Mass. Filed Nov. 20, 1893.

523,491. Block-Signal System. George L. Thomas, Brooklyn, assignor to the Hasell Perfected Railway Signal Company, New York, N. Y. Filed March 26, 1894.

523,566. Electricity-Counter. Francois A. Brocq, Paris, France. Filed Sept. 21, 1893.

ELECTRICITY.

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EDITORIAL NOTES.

The Niagara Project From Another Standpoint. In a previous issue we discussed the Niagara project from the commercial—from the dollars and cents—standpoint and found it wanting. We are too apt in this country to look at things from this point of view alone, and to disparage anything that will not meet commercial requirements. In criticising projects of this kind it is almost impossible for the public to divorce the project itself from the individuals connected with it, and the condemnation of the one carries with it by its own very inertia the condemnation of the other. We were at pains to avoid this by stating in several places that Prof. Forbes, Prof. Houston and Mr. Kennelly were able men who were employed to solve as best they could a problem that was given them by some one else. It matters not how absurd the problem might be from the commercial standpoint, they were expected to do the best they could with it, and we believe are doing the very best they can.

Now there is a very different point of view from this, viz., the *scientific* point of view, from which the element of profits in the form of dollars and cents is entirely removed. Looking at it from this standpoint the Niagara project stands forth as the grandest of the centuries. There will be immense profits from it also, which *cannot* be measured in dollars and cents because of the far-reaching effects of the experiment even though it be a disastrous commercial scheme. How much money has been spent, apparently fruitlessly, in evolving the incandescent lamp, without which there would be to-day practically no commercial applications of electricity, no one to-day can tell. Pioneer inventors in other lines have spent all their own money and all of their friends' that they could borrow before they arrived at commercial results, and were called fools for their trouble, but the world at large is immensely more comfortable and more wealthy for what their contemporaries were prone to call "fool work." Some of these have lived to receive the homage of the whole world. Others died in poverty and the second generation or a later one has received the financial reward, and has erected over the unmarked grave of the "crank" of the former generation a fitting monument to his genius. Goodyear is a striking example of this latter class—dying poor and without honor, and yet what a monument has he erected to himself in the work he did under circumstances that would have discouraged many another equally zealous worker! Faraday was honored beyond the usual of men during his lifetime, but was constantly having thrust in his face the question *Cui bono?* But what is his honor to-day? The best informed physicists that the world knows are constantly referring to Faraday as an authority, but his little experiments in the laboratory brought him no direct financial returns, nor did it appear at the time that they ever would, yet the little spark which he produced has grown to the huge dynamo of 5,000 H. P., and has given rise to an industry that in this country alone involves hundreds of millions of capital. It was this little spark which made possible the great Niagara experiment. It was this little spark also that gave rise to the Frankfort-Lauffen experiment, which had for its purpose the settling of many questions in the transmission of energy at high potentials to long distances. This experiment—which consisted in the attempt to transmit 300 H.P. from Lauffen, at the Falls of the Neckar, to Frankfort, 108 miles—had no immediate commercial objects in view. It required governmental aid for its completion; some of the very best engineering talent was also employed in its planning and carrying out. From one point of view it was a failure. The efficiency of transmission was unexpectedly high, yet power could be generated more cheaply at Frankfort than it could be transmitted by electricity from the Neckar. It was intended to use 30,000 volts. Scarcely more than half of this was ever used. But it settled the questions it was intended to settle, and a great many more that hadn't been thought of. It placed the subject of electrical transmission of power at once upon an enormously higher level than it had ever occupied before—it was epoch-making. Though a failure in one sense, it was one of the most profitable failures that this world has ever seen, and none of those connected with it are ashamed of their part in it.

Coming now to the Niagara project and looking at it from the same standpoint from which the Lauffen experiment is seen to have been a success, it is such a long step in advance over that tried at Lauffen as to almost take one's breath away in contemplation of it. The completion of the plant is so near at hand that we can already almost hear the wheels turning. Instead of transmitting a paltry 100 H. P., as was actually done at Lauffen, it is proposed to transmit thousands of horse power to distances greatly exceeding that in the other experiment. One cannot but admire the genius that has planned and almost completed this stupendous enterprise. Did one not know the names of those who have been called upon to assume this responsibility he would at least know that they belong to master minds. No higher compliment could be paid to Prof. Forbes, Prof. Houston and Mr. Kennelly than their selection for the important posts to which they have been called.

The Niagara project is doomed to failure of the same kind as that at Lauffen, but it is going to be epoch-making as was the other, only it is going to mark a more important epoch than has ever before been marked. Though a failure, it will be one that will be honorable to the gentlemen named, and one with which they and their friends will be proud to have their names associated.

The real question at Niagara would seem to be that of transmission. There are, however, several subsidiary questions of course, as there were at Lauffen. A new system was involved in both. How will the one to be tried at Niagara compare on an equal footing with the Drehstrom, which had hardly been heard of before 1891? how will the insulation as planned stand the higher electromotive forces working against it? etc. Then at Niagara a feature enters that did not appear in the former. At Lauffen it was merely a question of transmission—the question of distribution did not enter at all, practically, but at Niagara it will be a most important feature.

As regards transmission, we know that theoretically we can make its cost as little as we please by making the voltage sufficiently high, but how high can we in practice make it? At Lauffen it was proposed to use 30,000 volts. They did not succeed, we believe, in using more than about 16,000. So far as we know from experiment, the latter figure is now the limit on large installations. At Niagara it is proposed to use 20,000 volts. Experiment will soon show whether or not this voltage is practicable. If it proves to be, doubtless higher voltages will be tried and we may have a new datum point of say 30,000, 40,000, 50,000, or perhaps even 100,000 volts to count upon as practicable hereafter.

In the matter of insulation we have made some real progress since 1891, and there has been a good deal of progress of a rather hypothetical kind—such as looks reasonable on paper but which has never been put to working tests. These latter methods of insulation will all be tried, and many more will be brought out by the demand from the Niagara Company for something that will withstand successfully even greater strains than anything now known. The experiment will doubtless give us much fuller information on this subject than we have had.

In long transmissions the fixed charges on lines are necessarily large. The line must be *well built*, *strong* and *cheap*. We will probably learn how to build a strong line much more cheaply than we can now.

The question of periodicity of the currents and their mutual and individual effects is one that is much mooted. That will doubtless be settled as well as a thousand and one others, and when all these things are settled the world will know it and can then figure out to a nicety the probability of success in proposed lines. The fuel account in an operative station forms but a small percentage of the total operating costs of the station. If the interest on the cost of a water power and of line construction to a distant point is greater than the fuel charges at that further point, the waterfall of course cannot compete with the fuel pile. The fixed charges at Niagara must be very great. The fuel charges at some places are very small. When we know how most cheaply to transmit our power, it will be a very simple matter to calculate to what distances the one can compete with the other. This will be not the least of the benefits that will result from the Niagara experiment.

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Still on the Make. "Electricity at the World's Columbian Exposition" is the title of a book which has just been issued. The name of "Professor" J. P. Barrett appears as the alleged author. Exhibitors in Electricity Building who were in attendance throughout the Fair did not notice the "Professor," note-book in hand, strolling about and gathering material for his work. They did not see any paid representative of the "Professor" performing a like service for him. So the question arises, Did he do his work at night, or has he written up the exhibits from memory with the aid of photographs purchased on the street?

We think not. In fact, we are sure he has not written anything on the subject. It is remembered that an official request, signed by "J. P. Barrett, Chief of the Electricity Department," was made upon all exhibitors to furnish him with a complete write-up of their exhibits, with photographs, which write-ups, so it was stated, were to be incorporated in an official report. Later, Mr. Barrett announced that the official report would not appear for a couple of years, and that he would soon issue the work which has now appeared. We venture to say, and we challenge "Professor" Barrett or his man Friday, Hornsby, to deny that this matter, procured by "Professor" Barrett by reason of his official position, has been used by him personally and for his personal gain. The value of the work scarcely needs comment. Write-ups of their own exhibits, furnished by the exhibitors, must of necessity be discriminating and historically correct. The danger is that they would be too modest in tone.

What we wish to call attention to is the delicate sense of the proprieties which is manifest in all that the great "Professor" does and to his sublime modesty. He announces that he was the first man to successfully run electrical wires underground; he tells a reporter in confidence that he and Edison and Thomson can command any salary they ask; and at length proclaims himself the author of a work of which his previous literary and "technical" productions show he could not have written more than the title page and the captions under the illustrations.

We propose to examine the book carefully and make a further report on what we discover. We hope to find a report from Mr. Hornsby showing how much the authorities had to pay Owens and the other electro-medical quacks for exhibiting in Electricity Building; also how much the authorities lost in fitting up Newspaper Row at the rate charged, $248 to each newspaper, supplying material that could not have cost over $100.

We note in the advertisement of the work in question that there are 100 full page illustrations, an equal number of smaller cuts, and "originally engraved initial letters and chapter tails" If this is correct the initial letters and chapter tails are the only original things in the 500 pages.

Let us hope that the work is itself a chapter tail—the last evidence we shall have of the humiliation which the electrical trade of America suffered when a Barrett and a Hornsby were chosen to manage the Electrical Department of the Chicago Exposition.

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THE Cleveland General Electric Company, lately reorganized and rejuvenated, has shown exquisite judgment in changing its name to "The Cleveland Illuminating Company." Before two years have passed it will be seen that the words "General Electric" will damn any company using them in its title. Other local companies will soon be compelled to copy the Cleveland company if they wish to preserve their credit, and the parent company will long before that time have changed its name, its policy, and its officers. The name will only be preserved to history as it appears on worthless stock certificates which will turn up from time to time in the Ann street junk shops.

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THE Cincinnati Edison Company has been proceeded against for maintaining a common nuisance in the form of its artesian wells, which, it is claimed, give out malodorous and deadly gases which permeate the neighboring residences and "turn silver into lead." We have always known that Mr. Andrew Hickenlooper was a hard fighter, but never supposed he would put up such a job as this. The probability is that the bad smells come from one of Mr. Hickenlooper's own gas pipes.

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An official of the General Electric Company says the company is doing 70 per cent. of the business of a year ago.

THE business for the last fiscal year was about $8,500,000, 70 per cent. of which is $5,950.000. This is a little worse than we had supposed, but being official must be accepted as correct.

The blackmailing campaign of patent suits against individual users of incandescent lamps in Philadelphia has received several checks. Judge Dallas has rendered one decision that the Buckeye lamps can be lawfully sold there. From the way his decision was worded we think he will be sure to render a similar one in favor of the Columbia Company when a case comes before him. The local Edison Company has also made a serious mistake in attacking Burnham, Williams & Co., of the Baldwin Locomotive Works. The latter have announced their intention to spend all the money which is necessary, and have made an elaborate answer to the application for injunction covering the entire subject of incandescent lamp invention. This answer reads like a leaf from ancient history. The following names are given of those who knew of the incandescent lamp before Edison's "invention" appeared: Sawyer, Man, Maxim, Weston, Adams, Farmer, Osborne, Goebel and Freeman. We infer from the developments in this case up to date that Messrs. Burnham, Williams & Co. don't propose to be bulldozed, and we guess they won't be.

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The *Boston Herald*, whose news is almost invariably correct, says:

> An officer of the General Electric Company says prices of supplies of all kinds are, of course, much lower than they were a year ago. Electric cars with motor equipment are selling from $500 up. There has been a corresponding decrease in the prices of arc and incandescent light lamps.

We knew that the General Electric Company had sold complete car equipments (two 25 H. P. motors) at the rate of $675 per car. This was a month ago. If now another cut of $175 per car has been made, the strides which the company is making towards bankruptcy are more rapid than we had supposed. The fact is becoming more and more apparent that the company has lost its grip on the trade, and instead of improving its condition is going from bad to worse every week. However, as long as the company can retain the semblance of an organization, the insiders can continue to make money on stock manipulation. This is their only object. It is unfortunate for rival manufacturers that this condition exists, but it cannot exist for any great length of time. The end must soon be reached, and prices may then have a partial recovery.

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The communication from Mr. Thos. D. Lockwood, printed last week, arrived too late to receive proper editorial attention. Although late, we desire to thank Mr. Lockwood for the article and to compliment him upon his knowledge of Biblical matters. Some such man is needed in every well-ordered newspaper establishment, and we have one on our staff. Unfortunately, he was away on a fishing trip when Mr. Warrand's Mosaic theory reached us, and could not be consulted. Our office cat is not of a religious turn and also failed us in the emergency. The Bible editor is now on duty, and we trust that our Scriptural department will not again be subject to criticism.

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Our London contemporary, the *Electrical Engineer*, says that Prof. Gray, the inventor of the telautograph, lives in New York. With its usual accuracy, it missed it by 900 miles.

The Narragansett Station.

The work of addition and improvement on the Narragansett Electric Lighting Company's station at Providence is now in rapid progress and will be finished by September 1. There is to be a new building located on the south side of the east end of the old structure, 117 feet 8 inches by 45 feet, built entirely of steel and glass.

The increase in the plant itself is to comprise three new engines, three generators, two additional batteries of boilers and an independent vertical condenser and pump. The generators are to be of 750 horse power each, two of them direct connected.

The work of extension is in charge of Mr. John J. Moore, who is now the general manager of the Narragansett Company. The station, when completed, will be the finest one in the country, supplying both arc and incandescent lights and power on a large scale.

The Siemens & Halske Fire.

The works of the Siemens & Halske Company of America and the Wells & French Ca Company, of both of which Mr. O. W. Meysenburg is president, were destroyed by fire on the 1st inst.

Mr. Chas. D. Shain, the Eastern representative of Siemens & Halske, received the following telegram the day after the fire:

> "Factory burned. Will resume manufacturing immediately and deliver within ninety days. Patterns and plans saved."

The fire at this time is in the nature of a public misfortune, and we trust that arrangements may be made whereby the company can carry out their contracts and not lose one inch of the ground they have gained. They cannot well be spared from the field even for one month.

Westinghouse Stopper Lamps.

The Westinghouse Electric Company has contracted for a glass factory with capacity to turn out bulbs and stoppers for 30,000 incandescent lamps a day, the buildings to be completed within 60 days. The company now receives from the glass works 9,000 bulbs and stoppers per day.

The directors of the Cedar Lake Electric Company of California have issued their first annual report, in which they give some interesting details regarding their enterprise, which embraces the project of transmitting power electrically from Clear Lake to San Francisco, a distance of 75 miles. It is proposed to run three lines of steel pipe of five feet average diameter a distance of 40,800 feet to the generating house, where the water, delivered at 454 feet head at the Pelton wheels, will furnish a total of 28,950 horse-power. At the estimated percentage of loss in transmission, this would net 20,845 horse-power in San Francisco. It is proposed to employ 1,000 horse-power generating units and 25,000 volts electromotive force on the line and two pole lines each carrying 10 circuits. Besides the pole line, a pipe line across San Francisco Bay and Benicia Straits will be necessary; and 25 miles of conduit for distribution in the city. The cost of the hydraulic plant is put at $1,005,197, and of the electric plant complete, with all circuits, $2,931,680, making a total outlay of $3,936,877, or say $4,000,000 in round figures. Fuel is costly in San Francisco and power costs $10 per horse-power per month. The Clear Lake Company intend to sell at $5 per month, which, it is estimated, would yield $1,200,000, or deducting all expenses of operation, $900,000 a year, which would be 20 per cent. on the investment.

Permission was granted by the Swiss Government authorities during last year for the establishment of 34 electric lighting plants (26 on the continuous-current system and 8 on the alternate-current), 5 electric power transmission plants, 7 combined electric lighting and power transmission plants, and 1 electric tramway.

A Bolometric Study of Light Standards.

BY CLAYTON H. SHARP AND W. R. TURNBULL.

III.

Method of Taking Observations.

All determinations of the variations of standards were made at times when the laboratory and its surroundings were very quiet. Most of them were made between the hours of seven and twelve in the evening; a few were made on holidays, when the laboratory was closed for general work. Before beginning a set of observations the sensitiveness was adjusted, and the galvanometer was carefully watched for a considerable time to get the amount of its swings due to currents of air about the bolometer strips or to changes in the earth's field. The sensitiveness was also tested from time to time in order to find whether this was variable or not. If swings of the galvanometer greater in amount than two-tenths of a scale division, or any irregular changes in sensitiveness, were detected, no run was attempted. Since two-tenths of a scale division amounted to only about 0.5 per cent of the total deflection in most cases, and since the variation in the light sources themselves were many times two tenths of a scale division in the case of all the standards except the Carcel lamp, this amount of error was considered entirely negligible.

After taking these preliminary observations, which usually required about an hour's time, the bolometer was exposed to the source of light. After waiting a few minutes for the strip and the surrounding parts to be thoroughly heated, the galvanometer deflections were read rapidly by one person, and were plotted by another as fast as they were read, the time being taken from a watch. In this way curves were traced which represent very truly all the changes in the radiation of the light source. This method of recording observations was found to be much preferable to the ordinary one of noting galvanometer readings and plotting them afterwards, both in point of saving of time and in accuracy attainable. It made possible, not only more numerous readings, but also the giving of oral instructions to the recorder, and the consequent plotting of curves which, in correctness of their minor as well as of their major details, would be but little surpassed by a photographic record.

An unfortunate feature in these curves is that the scale of abscissas, representing times, is so small. As a result of this it has been difficult to represent with the greatest accuracy the true dimensions of those portions of the curves which correspond to very small waves in radiation. In examining the curve it should be remembered that a very steep line may cover several seconds of time, and that it is quite possible that a photometric setting might be made during the time that a candle is executing just such a variation as is represented by the steepest parts of one of the candle curves.

The number of galvanometer readings plotted during the space of five minutes was usually from 50 to 100.

At the end of a run the strips and surrounding parts were given time completely to lose the heat imparted to them, after which readings for zero and sensitiveness were taken. To correct the curves for changes in zero and in sensitiveness, a plan was followed which was justified only by the fact that the error introduced by employing it was entirely insignificant. Change in sensitiveness was reduced to ordinates of the curve by means of the equation—

$$\frac{\text{change in sensitiveness}}{\text{initial sensitiveness}} \times \text{approximate mean ordinate} = \text{correction to ordinate.}$$

This was combined with the drift, and a point was placed on the cross-section paper having its ordinate such as to represent the combined effect of drift and change of sensitiveness, its abscissa being the time of taking observations. This point was joined by a straight line with a point on the axis of X at the time of taking the initial zero readings, thus assuming that the drift and change of sensitiveness had been regular during the run. Then, if the initial sensitiveness happened to be unequal to the sensitiveness which was taken as standard, by an equation similar to the one given above, a correction to all the ordinates was computed to reduce the curve to the standard sensitiveness. If the distance of the light source from the strip was other than that taken as a standard, a similar correction was computed for this. These two reductions were then combined, and a line was drawn parallel to the first correction line and distant from it by an amount equal to these combined corrections. The mean ordinates of the curves, reckoned from the new base line so constituted, represent their relative quantities of radiation of the sources of light. The curves were then traced on bond paper, the axis of abscissas on which was put so as to fall on the correction line on the original draught on section paper. Since the corrections which have been spoken of above were all small (except in the case of curves XVI and XVI *a*), neither the proportionality of the variations to the total deflection, nor the slope of the lines of the curves, has been materially affected.

Before setting out on the work it was feared that the inertia of the moving parts of the galvanometer might have a decided effect on the accuracy of the results obtained, in that it would tend to exaggerate the rapid changes. This fear was found to be groundless. In the first place, the galvanometer was, as has been said, very nearly dead beat. Although the bolometer strip followed almost instantly every fluctuation of the source of radiation, the fluctuations themselves were not usually so rapid that the galvanometer needles were driven with any considerable velocity. Consequently the tendency of the needles to oscillate in their natural period was very slight. That the inertia of the moving parts had very little, if any, influence on the shape of the curves was shown by the fact that at the end of most swings the needle would pause for some seconds before beginning its return, while it rarely happened that the angular velocity did not change during a swing.

It has been impossible to draw the curves so as to show clearly these variations which involved only a few seconds of time, since, as has been said, the scale to which the time abscissas are plotted is very small compared with the scale of ordinates. These important peculiarities of the movements of the galvanometer needle were clearly perceptible, however, to one who observed the galvanometer deficiencies for only a little time, while their character made it perfectly evident that the swings of the galvanometer needles in their natural period exercised only an inappreciable influence on the slopes of the curves and the magnitudes of the variations recorded.

On the plates the smallest divisions of abscissas represent five minutes of time. The corresponding divisions of ordinates are five divisions of the galvanometer scale. In order to economize space, no attention has been given to the height of the curves or to the base line on the plates. The total ordinates for each curve are indicated by such a symbol as this $\left.\begin{matrix}\mathrm{I}\\\mathrm{II}\end{matrix}\right\}$ 40, indicating that the true X axis for curves I and II should be placed 10 divisions below the base line on the plate. Consequently on the various plates curves having the same ordinates are plotted one above the other, the true ordinate being indicated in the way mentioned above.

IV.

Discussion of the Results Obtained.

The bottom, i. e. the larger end of the candle, was hollowed out to expose the wick, and readings were taken after the candle had been burning long enough to come to its normal light-giving power. The agreement in the amount of radiation of the candle burned from the larger end, with the amount when burned from the smaller end, shows that the variation in the diameter of the candle has little if any influence on the intensity of the light emitted.

One marked peculiarity, which characterizes to a greater or less degree all the curves, is the succession of sudden drops followed by gradual rises to a maximum. In the case of the drop, in one instance at 55 minutes, the change amounted to 15 per cent. of the total deflection, and in other instances the change was nearly or quite as large. The reason for these drops is to be looked for in the action of the wick, which, as the candle burns down, projects farther above the spermaceti, causing a tall flame. Finally, by reason of charring and because of its own weight, it bends over, and the end burns off. The flame, following the wick, becomes shorter and sometimes broader. Since the wicks in the English standard candles are very uniform in construction, these drops succeeded each other after more or less regular time intervals, which were, in most cases, not far from three minutes. The curves show also a comparative freedom of these flames from minor fluctuations due to disturbing draughts of air. The ordinates of the English candle curves are not corrected for rate of burning.

The general level of the German standard paraffine candle curves is rather closely adhered to. The numerous minor fluctuations show that the flame of this candle is quite subject to disturbances by draughts. Occasionally the flame increases to a size far beyond its normal, and smokes. These large fluctuations, extending over a considerable period of time, form a marked feature of the curves. In some cases it did not reach its normal light-giving power until fifteen minutes later than at others.

When we come to compare the English with the German candle, we notice, first, that the variations of the English candle were much larger and that large variations were much more frequent. The German curves are free from the semi-periodic drops which characterize the English. One German curve at twenty-four minutes reaches a value which is 1.235 of the mean ordinate of the English candle curves. Another at forty-nine minutes drops to a point which is only 0.77 of the mean ordinate. The total variation is, consequently, 46.5 per cent. Both of these curves were taken with the same candle, but on different nights. The highest point of the German curves in one instance is at eighty six minutes. The ordinate reaches a value which is 1.155 of the mean. The lowest point is in another case at seventy-two minutes, and is 0.915 of the mean. The total variation was consequently 24 per cent., or only about half that shown by the English candle.

Moreover, we see that the percentage deviation in still another curve, fifty-five to sixty minutes, from the mean of the English candles is + 10.45 per cent. Another, thirty-five to forty minutes, shows a deviation of — 13.08 per cent. The total deviation for a period of five minutes is 23.53 per cent. for the English candles. In the German candles the maximum positive and negative deviations for five-minute periods are + 11.52 per cent. and — 10.43 per cent. respectively. These give a total of 21.95 per cent. and exhibit a performance but little better than that shown by the English candle.

These figures make perfectly evident the futility of any attempt to get concordant photometric results from freely burning candles, unless, indeed, a very long series of observations is taken. In favor of the English candle it can be said that its flame is more stable and is much less subject to smaller fluctuations than is the German candle. When it comes to measuring the dimensions of the flame and reducing readings to a standard size of flame, there is little doubt that the English candle would be found much superior to the German. In the early part of the work with candles a rather rude measuring device was set up and heights of flame of the English candle were determined and compared with the corresponding galvanometer readings. The accordance between definite flame heights and definite galvanometer readings was found to be very close.

Investigations along this line have not been prosecuted farther for lack of another observer. A device has been made, however, by which it is hoped that the height, or the height and the width, of a candle flame can be measured with great quickness and accuracy, and it is the purpose of one of the present observers to attempt to ascertain, by means of this measuring apparatus and the bolometer, whether the radiating power of a candle can be expressed conveniently in terms of its simpler dimensions or not. That the light-giving power of a candle must vary directly with the cubical contents of the luminous portion of its flame, provided the surrounding conditions are unaltered, seems obvious. That the relative luminous intensities of candles of different materials can be determined with a fair degree of accuracy by measuring the cubical contents of the light-giving portion of their flames, has recently been shown by Glan.* For photometric work, however, it is essential that the luminous intensity at any time should be deducible from simple measurements of the flame —such measurements as can be made the instant before or after a photometer setting is made.

(*To be continued.*)

The Cost of an Indicated Horse-Power.

An interesting paper under this title was submitted at the recent Montreal meeting of the American Society of Mechanical Engineers by De Courcy May, who summarized his subject in the following table, showing the total cost of 1 I. H. P. per annum for various engines:

Kind of Engine.	365 Days of 24 Hours. Coal per 2,240 lbs.				308 Days of 10¼ Hours. Coal per 2,240 lbs.			
	$ 2	$ 3	$ 4	$ 5	$ 2	$ 3	$ 4	$ 5
Triple-expansion, pumping, Allis, 20 revs.	48	55	61	67	31	33	35	37
Triple-expansion, without pumps, Allis, 50 revs.	27	33	39	45	16	18	20	22
Compound mill, best engine	29	36	44	51	17	19	21	24
" " average	39	46	52	28	22	25	28	30
" electric light average	122	139	159	174	78	84	90	96
" trolley	48	58	68	79	29	32	36	39
Triple expansion trolley	45	54	64	74	26	29	33	36
Condensing mill	45	52	61	69	25	29	33	38
Non-condensing, 50 to 200 horse-power	70	76	81	88	49	53	57	60

The figures for engines below 50 H. P. vary so widely that they have been omitted. The above table has been calculated as far as possible from actual engines running under ordinary conditions, but it is not pretended that the figures represent true average values, the writer not having been able to collect information from a sufficient number of cases. The engines are nearly all high-class and of large powers; the figures in the table are therefore rather below than above the average.

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* P. Glan, Ueber ein Gesetz der Kerzenflammen, Wied. Ann., Vol. LI, p. 584.

THE DEVELOPMENT OF THE ELECTRIC TELEGRAPH.—VI.

BY STEPHEN VAIL.

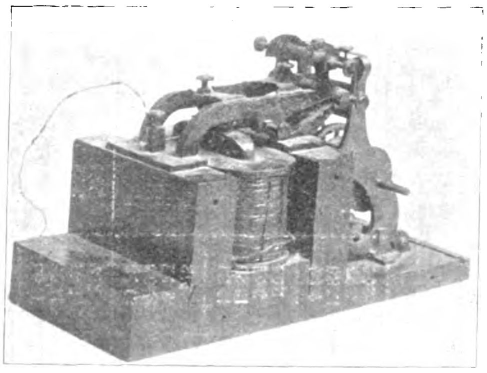
A recent writer has stated: "Prof. Henry had discovered the power, and reduced it to actual practice in mechanism, which Prof. Morse, in his dreaming, was then longing and hoping for. Thus, Prof. Henry was the legitimate father of the American electro-magnetic telegraph, in one form. But the child of Prof. Morse's dreams still needed a body to be of any practical service to the world. This was finally furnished by Mr. Alfred Vail, of Morristown, N. J."

In the New York *Times* of August 25, 1883, appeared a communication signed "Investigator," written by a gentleman of high attainments and deep research, in which were the following statements: ". . . . I have somewhere among my papers, carefully laid away, the first form of a letter, written in his own hand, by Prof. Morse himself to the British Attorney General, who is, or was, ex-officio the 'Patent Commissioner' of Great Britain, in 1844, perhaps in 1843, which letter Morse (in order to make his claims intelligible to the man, whom he thought to be thick-headed, but who was very sagacious and happened to know too much for Morse, as the sequel proved) commenced with a series of disclaimers—stating that he did not invent this and that; and he concluded the letter with claiming to have 'invented' only two things which he wished recognized as his, to wit: first, a mechanical means of making marks upon paper—I forget the name, and it was of no practical account; and second, the sending of a communication over a single wire. This was Morse's strong point, but even it was not his actual discovery, but it was accorded to him through a legal conclusion in the construing of a contract which existed between him as the one party and Prof. Gale and Alfred Vail as the other party.

"The late Hon. F. O. J. Smith, of Portland, Maine, a very able man, knew precisely how little were Prof. Morse's merits—in short, knew what a gilded humbug, as touching the telegraph, he really was. Morse had good reason to suspect that Mr. Smith would sometime let the world know all about the matter—and he was right in his suspicion. That letter to the Attorney General of Great Britain would alone dash pretty much all that has ever been claimed by Prof. Morse and his friends in his honor.

"There are other facts which go to show that the 'Morse telegraph' is not Morse's, and that the late United States Judge Levi Woodbury, Hon. Salmon Chase, and several other distinguished gentlemen, at various times engaged in 'telegraph suits,' all knew that Morse's claim to the invention was but a shadow at best, and I had the confession direct from the lips of the late Hon. F. O. J. Smith, that at one time, during the trial of the celebrated case of 'F. O. J. Smith vs. Hugh Downing,' before Judges Woodbury and Sprague, in the District of Massachusetts, in 1850, he (Smith) trembled lest the facts in the case be exposed, so near did the opposing counsel chance to get at them; but, fortunately for him, the ignorance of the eminent counsel of the science of telegraphy of that time was such that a dangerous question, the real merits of which the counsel putting it did not comprehend (and put to Prof. Morse himself, I think,) was skilfully parried by an 'objection' from the other side, and a shrewd argument thereupon—by which the counsel were 'obfusticated.' The counsel never suspected how near they came to catching the weasel. This means simply that Mr. Smith's case, so saved, saved Prof. Morse's reputation and claims for that time. . . .

". . . I therefore now crudely make a few 'points,' or take sundry general positions, namely: First, that then (1837) Morse had *not* 'simplified all the ideas and made his discovery a success.' Second, that at that time Morse had not conceived, and at no time did ever conceive, independently, anything whatever which belongs to what the public to-day know as the 'telegraph system' (I mean by this that Morse 'invented' nothing of the telegraph so far as concerns its mechanism or the application or adaptation of the principles of service involved in its use; in short, that the 'Morse telegraph' is not and never was Morse's conception). Third, that the register everywhere used to-day was the invention of the late Mr. Alfred Vail, of Morristown, N. J., a gentleman of liberal education, extensive scientific acquirements, and a man of large capacity as an inventor—which register, the first (once in my possession), was *sent* to Morse, while in Europe (1842-3-4), and which he never saw before; that the 'Morse alphabet,' so-called, was Mr. Vail's invention, too, (as was also the 'House' telegraphic printing system, improved by House); that the discovery that the earth would form a part of the 'circuit' was Mr. Vail's (by this I mean that Mr. Vail, and not Prof. Morse, discovered the fact in this country, in ignorance that Steinheil had discovered it in Germany, as so claimed, some years before); in brief, that to Mr. Vail is due the credit for the success of the telegraph, mechanically considered, as well as sundry scientific discoveries relating to its operation. Fourth, that to the late Prof. Lorenzo D. Gale directly belongs the credit of bringing to Prof. Morse's knowledge, in 1836, the 'intensity magnet' of Prof. Henry, without which the telegraph would be of no practical account."



From a Photograph of the only remaining Instrument of the two used upon the line between Washington and Baltimore. It was upon this instrument that the message, "What hath God wrought!" (sent by Morse at Washington) was received by Alfred Vail at Baltimore on May 24, 1844. The instrument is now in the National Museum at Washington, having been loaned to it for exhibition by Stephen Vail, to whom it was left by Alfred Vail, his father.

The correspondence, notebooks and private papers of Alfred Vail, relating to his connection with the telegraph, have been deposited by his sons with the archives of the American Historical Society, in the vaults of the Smithsonian Institution at Washington, and in these papers may be read the history of the invention, as well as many letters from noted men of the time as to its use and probable effect upon business and the country. Some of them deal with the question of the Government's control of the telegraph, and show that the sentiments both of the inventors and of the greater statesmen of the time were in favor of the United States Government owning and operating the new invention.

In further evidence of the part in the telegraph taken by Alfred Vail, the man who, according to the statement made to the world by S. F. B. Morse, only "*furnished the means to give the child a decent dress, etc.*," I will make an extract from my father's papers: "After the close of the session of Congress in the spring of 1844, a series of experiments was commenced by the request of Prof. Morse, *under my direction*, for the purpose of ascertaining what amount of battery was absolutely required for the practical operation of the telegraph. From the commencement of its operation to the close of the session, so anxious was the public to witness its almost magic performances that time could not be taken to put it in a state to test either the size of the battery required or bring into use all the machinery of the register. On that account but *one wire* was used during that period for transmitting and receiving intelligence, and the capabilities of the instrument were shown at some disadvantage—requiring the constant attendance of those having charge of the two termini. The first experiment made was to ascertain the number of cups absolutely required for operating the telegraph; eighty cups had been the number in use. Upon experimenting it was found that two cups would operate the telegraph from Washington to Baltimore. The success was more than had been anticipated and urged on further experiments, which eventually proved that the earth itself furnished sufficient galvanic power to operate the electro-magnet without the aid of a battery. In the first experiment a copper plate was buried in the ground, and about three hundred yards from it a zinc plate was also buried. To each of these plates a wire was soldered and the ends brought into the telegraph office and properly connected with the key and electro-magnet of the register—the battery not being in connection. Upon manipulating at the key it was found that the electro-magnet was operated upon and the pen of the register recorded. This led to another experiment upon a more magnificent scale, and nothing less than that of using the copper plate at Washington and the zinc plate at Baltimore with the single wire connecting these distant points, the battery being thrown out. Here, too, success followed the experiment, though with diminished effect. By the application of a more delicate apparatus the electro-magnet was operated upon, and the pen of the registering instrument recorded its success. From these experiments the fact appears conclusive that the ground can, through the agency of metallic plates, constantly generate the galvanic fluid."

In his letters to Mrs. Vail, written at the time of the construction of the line from Washington to Baltimore, there is much of interest to be found, and relating to the work on the 11th of April, 1844, he wrote: ". . . I will inform you with what success with the telegraph. We have tried it six miles, though it is now put up nine miles, and by Saturday will be twelve. It has given the utmost satisfaction thus far and performs perfectly. A few days since I was at one end of the line and Prof. Morse at the other. From there he announced that the cars were passing, and, he says, *I answered him before the train had passed!* To-day we have put up the instruments at the Capitol where the wires terminate. We have two fine rooms, one for the instruments and the other for the battery, and we expect to have the whole line completed to Baltimore by the 17th of next month. The utmost curiosity exists about it, and when we get started we shall have our rooms constantly thronged with visitors. I am waiting, with the utmost anxiety to have the final trial made with the telegraph, to see what will be the fate of things. We expect to get another appropriation if this results successfully, and of this I have no doubt. Prof. Morse is on tiptoe, as you may well imagine. No one seems disposed to injure our wires and all goes on well. . . ." On April 18, 1844, he wrote: ". . . 'We have tried the wires for fourteen miles, as far as they have been put up, and they work well. We talk back and forth every day upon them. The work is proceeding and we shall soon be in Baltimore. I am so hurried and driven that I have not time to take my meals. I am up and off sometimes long before it is light, am gone all day and back at 6 o'clock." [To Washington.] "I go to Bladensburg, sometimes to Belleville, and other parts of the work. . . ."

(*To be continued.*)

Cost of Producing Electrical Energy.

BY B. J. ARNOLD.*

It was my intention when asked to prepare a paper upon this subject, to be read before this Convention, to point out some of the principal sources of loss in the operation of the present central station, and afterwards to assume an ideal plant, designed in accordance with the latest practice, and show at what price per kilowatt hour the average station could deliver electrical energy to the consumer.

After the paper was partially prepared on this basis, R. E. Crompton read before the Institution of Electrical Engineers of London a paper covering practically this ground, in which he shows that with coal having a calorific value of 14,500 B. T. units, and with boilers capable of evaporating 12 lbs. of water at a pressure of 150 lbs., and the losses so proportioned that 2½ lbs. of this coal will evaporate 25 lbs. of water, a kilowatt hour can be produced for three cents and delivered to the customer for six cents, leaving a profit of three cents over and above all operating expenses and interest on the investment. He figures that an average of 20 lbs. of steam per kilowatt hour is all that would be required for actual service.

Mr. Crompton's paper having covered practically the ground I had mapped out, has led me to abandon my original plan, in place of which I will present to you to-day the records of a number of central stations operating in this country and Europe, from which you can by comparison ascertain whether your stations are doing as good service as they should. I will endeavor also to suggest ways in which the earning capacity of stations now running can be increased.

The losses between indicated and electrical horse power in a fairly well designed high speed, belted, direct current station are about as follows: Engines 10 per cent., belts 4 per cent., dynamos 10 per cent., line 10 per cent., making a total commercial efficiency of 70 per cent.

In alternating directly belted plants the losses on engines, belts and dynamos are about the same as given above. The losses in the primary circuit are usually 5 per cent. Where there are many small transformers and when working underloaded, as they usually are for a large portion of the time in small central stations, the average loss will be about 10 per cent., although when they are working at their rated load they will give an efficiency of 93 per cent. to 95 per cent. The loss on the secondary wiring is usually 2 per cent. Combining these losses we find the average commercial efficiency of the alternating plant to be 65 per cent. In stations operating large engines belted to a countershaft the losses are practically the same as given above, except that the loss between the power delivered by the engine and the power delivered to the generators is usually about 20 per cent., making the commercial or industrial efficiency of the above systems 58 per cent. and 52 per cent. respectively, although there are many cases on record in which the losses are far greater than these, caused by unsoldered joints in the line construction or defectively designed and operated machinery.

Table No. 1, published recently in *L'Industre Electrique*, was prepared by J. Laffargue. I have referred to it here, as it contains the most complete information regarding foreign central stations that I have been able to secure. The stations are all located in Germany; two of them, those at Elberfeld and Hamburg, being direct current plants, the one at Cologne an alternating station, and those at Barmen, Hamburg and Dusseldorf direct current stations with accumulators as auxiliaries. The table enables us to compare the relative merits of the three systems, and, as will be noticed, the alternating station at Cologne produces 71 watt hours per pound of coal, and delivers a kilowatt to the customer for 6.65 cents. The station at Hanover produces the greatest number of watts per pound of coal, namely, 219, and delivers a kilowatt hour to the consumer for 5.2 cents, while the best result of all is shown by the station at Dusseldorf, producing, as it does, 185 watt hours per pound of coal and furnishing a kilowatt to the consumer for 4.54 cents. This would seem to indicate that there is an advantage in using accumulators.

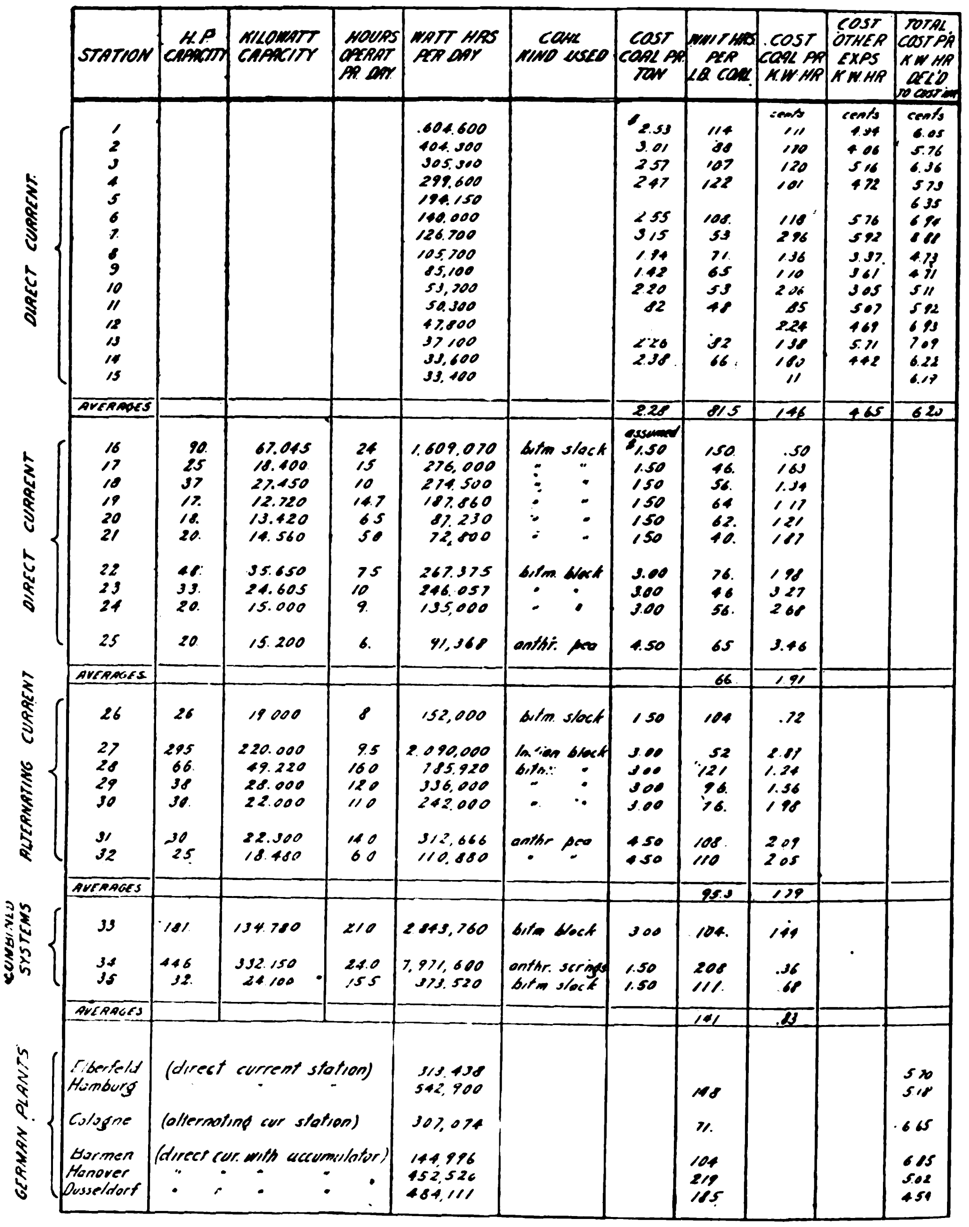
It is also interesting to note that the average commercial efficiency of the accumulators is 76.1 per cent.

M. Laffargue adds that the following percentages are allowed for depreciation: 1½ to 2 per cent. on the buildings, 4 to 5 per cent. on the boilers and engines, 6 per cent. on the accumulators, 3 per cent. on the mains, and 8 to 10 per cent. on the various auxiliaries of the plant. These figures are about correct for practice in this country, except on the accumulator question, and as there are now numerous strong companies entering the field in this country, who are willing to guarantee to maintain battery plants for 10 per cent. per annum, it is possible that we can soon reach the state of perfection in the line that is indicated by these figures.

In comparing the figures on a basis of cost per kilowatt hour delivered to the consumer, the loss in the mains at the various stations should be taken into consideration, as it will be noticed that at Dusseldorf the loss between the station and consumer is over 30 per cent., at Hanover 20 per cent., Barmen 15 per cent, while at Hamburg and Elberfeld it is but 5½ per cent and 2½ per cent respectively. Were these allowances made, it would probably bring the cost at Dusseldorf much below the present figure, but not knowing the exact conditions it was impossible to make the proper allowance in this paper.

The first part of table No. 2, marked "Direct Current," was prepared from reliable information on file in the writer's office, and is the result of the operation of fifteen large direct-current stations located in different parts of the United States. The three succeeding parts of the table, marked "Direct Current," "Alternating Current" and "Combined Systems," have been compiled from information secured from the report of the Committee on Statistics of the National Electric Light Association, presented at its last meeting, and figures were chosen only from such stations as seemed to bear evidence of careful

TABLE No. 2.



	STATION	H.P. CAPACITY	KILOWATT CAPACITY	HOURS OPERAT PR. DAY	WATT HRS PER DAY	COAL KIND USED	COST COAL PR. TON	WATT HRS PER LB. COAL	COST COAL PR. K.W. HR	COST OTHER EXPS K.W. HR	TOTAL COST PR. K.W. HR DEL'D TO CUST'M
									cents	cents	cents
DIRECT CURRENT	1				.604.600		$2.53	114	111	4.94	6.05
	2				404.300		3.01	88	110	4 06	5.76
	3				305.300		2 57	107	120	5 16	6.36
	4				299.600		2 47	122	101	4 72	5 73
	5				194.150						6 35
	6				140.000		2 55	108.	118	5 76	6 94
	7				126.700		3 15	53	2 96	5 92	8 88
	8				105.700		1.94	71.	1.36	3.37.	4.73
	9				85,100		1.42	65	1 10	3 61	4 71
	10				53,700		2.20	53	2 06	3 05	5 11
	11				50.300		82	48	.85	5 07	5 92
	12				47,800				2.24	4 69	6 93
	13				37 100		2.26	32	1 38	5.71	7 09
	14				33,600		2.38	66	1 60	4 42	6.22
	15				33,400				11		6.17
	AVERAGES						2.28	81.5	1.46	4 65	6 20
DIRECT CURRENT	16	90.	67.045	24	1,609,070	bitm slack	assumed $1.50	150.	.50		
	17	25	18.400	15	276,000	" "	1.50	46.	1.63		
	18	37	27.450	10	274.500	" "	1 50	56.	1.34		
	19	17.	12.720	14.7	187.860	" "	1 50	64	1 17		
	20	18.	13.420	6 5	87.230	" "	1 50	62.	1 21		
	21	20.	14.560	5 8	72,800	" "	1 50	40.	1 87		
	22	48.	35.650	7 5	267.375	bitm. block	3.00	76.	1 98		
	23	33.	24.605	10	246.057	" "	3.00	46	3 27		
	24	20.	15.000	9.	135,000	" "	3.00	56.	2 68		
	25	20	15.200	6.	91,368	anthr. pea	4.50	65	3.46		
	AVERAGES							66.	1.91		
ALTERNATING CURRENT	26	26	19 000	8	152,000	bitm. slack	1 50	104	.72		
	27	295	220.000	9.5	2.090,000	Indian block	3.00	52	2.87		
	28	66.	49.220	16 0	185.920	bitm. "	3.00	121	1.24		
	29	38	28.000	12 0	336,000	" "	3.00	96.	1.56		
	30	30.	22.000	11 0	242.000	" "	3.00	76.	1 98		
	31	30	22.300	14 0	312,666	anthr pea	4 50	108.	2 09		
	32	25	18.480	6 0	110,880	" "	4 50	110	2 05		
	AVERAGES							95.3	1 39		
COMBINED SYSTEMS	33	181	134.780	21 0	2.843,760	bitm block	3 00	104.	1 44		
	34	446	332.150	24.0	7,971,600	anthr. scrngs	1.50	208	.36		
	35	32.	24.100	15 5	373.520	bitm slack	1.50	111.	.68		
	AVERAGES							141	.83		
GERMAN PLANTS	Elberfeld	(direct current station)			313.438						5 70
	Hamburg	" "			542,900			148			5.18
	Cologne	(alternating cur station)			307,074			71.			6 65
	Barmen	(direct cur. with accumulator)			144,996			104			6 85
	Hanover	" " " "			452,526			219			5.02
	Dusseldorf	" " " "			484,111			185			4.54

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* Read before the Northwestern Electrical Association, St. Paul, July 19, 1894.

compilation. This report did not give the cost of coal per ton, nor the cost of coal per kilowatt hour, but simply gave the watt hours produced per pound of coal. By assuming a price per ton on the coal we have deduced the costs per kilowatt hour which are given, but not having the information necessary to ascertain the operating expenses or fixed charges, the total cost per kilowatt hour delivered to the consumer is omitted.

In general, however, I will state that the expense of operating in central lighting stations is approximately as follows:

Fuel	23.15	per cent.
Labor	21.20	"
Lamps	7.75	"
Repairs	13.10	"
General expenses	23.15	"
Other expenses	11.65	"
Total	100.00	"

(To be continued.)

Incandescent Lamps; Their Use and Abuse.

BY A. D. PAGE.*

In the present state of the art of incandescent lighting, in no way can central station managers increase the efficiency of their investment more than by careful study of ways and means of operating lamps in a manner which will insure an average maximum light at a minimum cost.

Too large a percentage of central stations judge the quality of lamps sold them almost entirely by their life, and even that poor basis of calculation is still further distorted by keeping no ampere records nor averaging results, but judging solely by the individual records of such lamps as may fail in the first hundred hours, or of those which live hundreds of hours past the point at which, from an economical standpoint, they should have been broken. The importance to central station managers of judging lamps which are sold to them from some better basis than individual or even average life can be better appreciated by referring to Fig. 1, showing curves of deterioration in candle power of lamps manufactured by different companies. In considering deterioration in candle power, it should be stated that it is a characteristic of every lamp which has yet been manufactured and should be considered entirely independent of blackening or discoloration of the bulb. Lamps may deteriorate to 50 per cent. of their initial candle power within two hundred hours and still show scarcely a trace of blackening. All lamps the curves of which are shown were purchased within six months in the open market in lots of from ten to twenty-five, and the curves are the average result obtained by starting each lamp at the particular voltage which would bring the lamp to exactly 3 watts per candle, maintaining the voltage constant throughout its life.

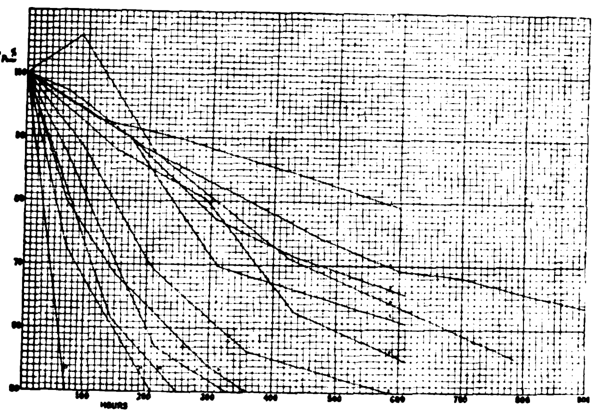

FIG. 1.

Curves Nos. 3, 5 and 6, Fig. 1, represent the best results obtained from the product of numerous foreign manufacturers. Nos. 4, 7, 8, 9, 10, 11 and 12 each represent a different domestic manufacturer.

While there is no reason to suppose that the average life of lamps shown by Nos. 4 and 7 will be shorter than that of lamps represented by Nos. 10, 11 and 12, there is also no certainty that it will be longer, and if a lamp is to be branded as poor by the central station manager because of the breakage of a small percentage of lamps in the first one hundred hours, then the advantage is in favor of the lamp which reached 50 per cent. of its original candle power in the first two hundred hours, thus maintaining the carbon at a high degree of incandescence with the necessarily greater strain of the filament for only a few hours.

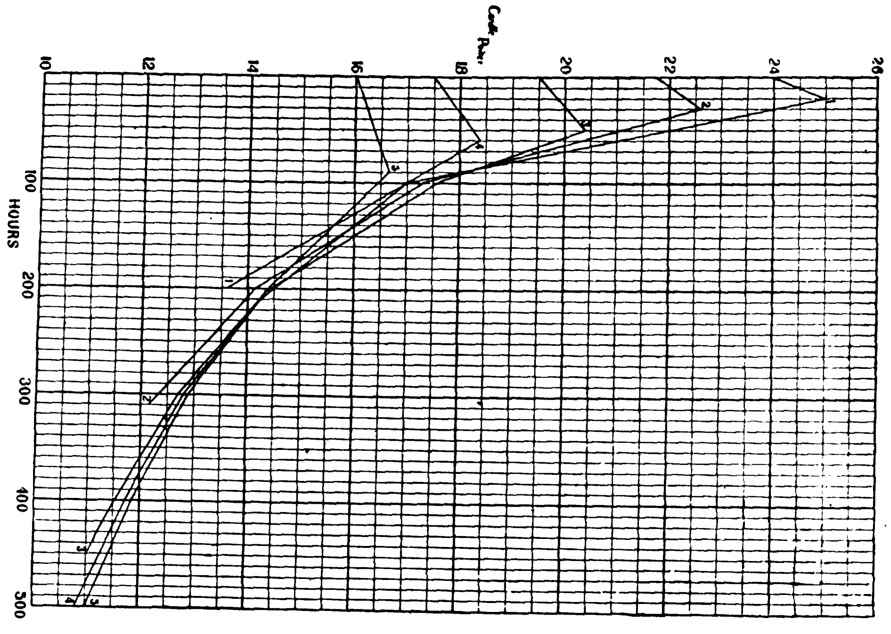

FIG. 2.

The carbon which maintains its candle power must continue to burn at a higher temperature, nearer the point of vaporizing, and is more likely to be destroyed by an abnormal increase in pressure than one which cools within the first few hours to a point where considerable increase in voltage is required to bring it to its initial degree of heat or incandescence.

From the standpoint of the central station, one of the worst guarantees that you could demand from the lamp manufacturer would be an individual life (for each lamp) of one or two hundred hours. The reason for such demand, when made on your part, arises from the erroneous impression that the lamp which lives only one to two hundred hours is necessarily defective. Nearly every lamp sold you, and particularly those which show the best results, rises in candle power for the first few hours (this is not shown in Fig. 1, as in only one case was the first test after the lamps were started made before the candle power commenced to drop).

On nearly every central station, particularly on alternating current stations during light load, the pressure on the primary is abnormally high. Add to this the difference between drop in the transformers and secondary wiring as between full and light load, and the result which a test is quite certain to show is pressure on the one or two lamps which the customer is burning during light load from 6 to 10 per cent. high.

Referring to Fig. 2, we find that burning a new 16 candle power 3½ watt lamp 7 per cent. high would for the first few hours raise its candle power to 25 and its efficiency to about 2.6 watts per candle. In less than one hundred and fifty hours, even maintaining the high pressure mentioned, the candle power and efficiency would fall below normal; but in the meantime the new lamps which have been burned under the above conditions have been abused to an extent which would be quite certain to make the showing of some individual lamps very poor, through no fault of the lamps.

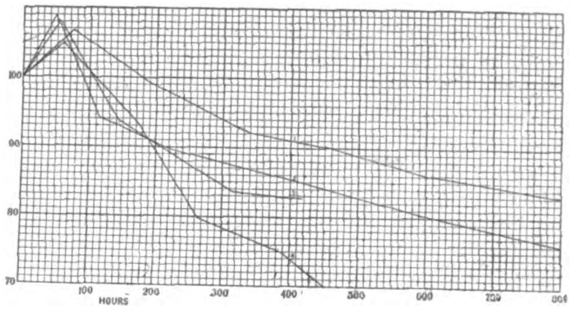

FIG. 3.

After lamps have been in use about two hundred hours, under average conditions, they could then be used where the pressure was high without bringing the carbon to a dangerous degree of incandescence.

One of the best illustrations I can give of the importance of your judging lamps from some better standard than simply life, is to refer to an incident of which I had reliable information, where a representative of the lamp company which manufactured the lamps shown by Curve No. 12, Fig. 1, exhibited the valuable quality possessed by his lamp standing very high pressure. With a rheostat it was exhibited burning from normal to a very high candle power. He represented it as the toughest filament ever placed in a lamp, and I have no cause to disbelieve him.

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* Read before the Northwestern Electrical Association, St. Paul, Minn., July 19, 1894.

If central stations run with a variation of from 6 to 20 per cent. in pressure they will find it necessary to demand tough lamps, the natural product of the amateur lamp manufacturer. To bring a product up, however, even from Curves Nos. 9, 10 and 11 to No. 4, means experience and thousands of dollars spent in experiments.

It also means that each one of over 50 different operations through which the parts of a lamp pass from start to finish should receive careful, intelligent handling or direction. Perfection in any one particular will not attain even average results.

The manufacturer of lamps shown by Curve No. 4 might have furnished the same carbons to manufacturers of lamps represented by Curves Nos. 10 and 11, and the result which they would obtain would not differ materially from that secured with their own make of carbons. Curve No. 4, though it represents as high an average grade of lamp of any voltage above 100 as has yet been furnished to the customers of any lamp manufacturer, does not represent the highest point which will be attained.

Curves Nos. 1 and 2 represent experimental lamps manufactured and furnished for test by the same company, whose regular product is represented by Curve No. 4, and I am informed by reliable experts that within a few months the entire product of the company will be brought up to the standard represented by Curve No. 1.

That the relative value of the lamps represented by these curves may be fully appreciated, let us take the average candle power of Curve No. 1, Fig. 1, which for six hundred hours is 1,419 candles, and we find, to maintain the same average candle power, using other lamps, we should have to break lamps represented by Curve No. 4, at five hundred and thirty hours; No. 7 at one hundred and seventy hours; No. 8 at one hundred hours, No. 9 at one hundred and twenty hours, No. 10 at ninety hours, No. 11 at seventy-five hours and No. 12 at thirty-five hours.

All of the lamps represented by diagram No. 1 are of voltages from 100 to 125 volts, and though started at a higher economy than is commonly practised by central stations (the 3.1 standard of Edison illuminating companies being the highest of which I have personal knowledge). Testing at 3 watts comes nearer to results obtained by commercial practice than a lower initial economy, as the tendency of the average central station is to run high.

Fig. 3 represents lamps of from 50 to 60 volts, started at 3 watts per candle, and tested under the same conditions as the 100 to 120 volt lamps. No. 1 is the product of the same factory as Nos. 1, 2 and 4, Fig. 1. No. 2 was manufactured by the same company as No. 9. No. 3 was manufactured by the same company as No. 11, and No. 4 was manufactured by the same company as No. 10.

As proven by these curves, and also, I believe, as generally acknowledged, it is much easier to produce a fairly good 50 volt lamp than one of a voltage above 100; but considering the progress which has been made within the last year in the high volt lamps, I believe that in a short time a large percentage of alternating current central stations will find it to their advantage to use large transformers and secondary mains on the three-wire system, covering one or more blocks from one transformer or bank of transformers and using only lamps of over 100 volts, thus greatly economizing in copper and securing much better regulation than is now secured with numerous small transformers and 50 volts on the secondary.

The importance of good regulation or a constant voltage at the lamps is too little appreciated, the general opinion of central station managers apparently being that so long as the life of the lamp is satisfactory to themselves or their customers, if they increase the voltage either temporarily or permanently the result would be to increase the average light. The facts are that burning lamps above their normal rating decreases the entire average candle power on the customers' circuits, and at the same time, if the station is on the meter basis, increases the amount of the customers' bills. This statement is particularly true of lamps only of average quality.

Referring to Fig. 2, No. 5 represents a 108 volt 16 candle power 3½ watt lamp burned at a constant voltage and reaching 11 candles at five hundred hours. Starting the same lamp at 110 volts or at 17½ candles, 3.3 watts per candle, and inside of two hundred hours the candle power curve crosses the one burned at normal. Starting it at 112 volts or at 19½ candles, 3.1 watts per candle, in less than two hundred hours the candle power curve crosses both the others.

Curves Nos. 1 and 2 follow the same general law. The higher we raise the voltage the more rapid the drop in candle power; and when we consider that the lamp represented by Curve No. 1 must be kept at 116 volts in order to give 14 candles of light after two hundred hours, and that should the voltage be brought back to normal or 108 volts, the candle power would be only about 9 candles, we can appreciate that on a station where the voltage varies even 7 per cent. the result must be a very uneven and poor quality of light, even though the life of the lamp is satisfactory.

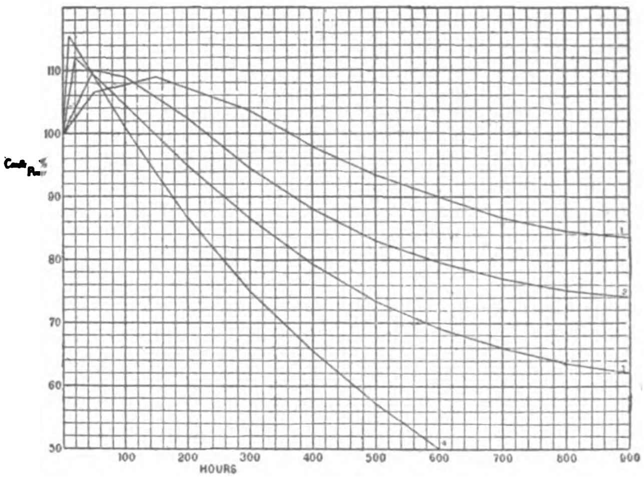

FIG. 4.

The tendency of all central stations seems to have been to gradually raise their voltage with the intention of thus either burning out or increasing the candle power of the old lamps on their circuits. The result is only to either burn out an abnormal number of new lamps or bring them down to the candle power level of the old ones within two hundred hours.

The only practical method of keeping the average candle power of lamps on a station at a point which will be satisfactory to customers, or on a competitive basis with other methods of lighting, is to keep records of the average life on the entire station where free renewals are furnished, and then to take out of the sockets and break up all lamps which are dim, by this means keeping down the average life to whatever constant is decided as the best under local conditions. Where lamps are sold to customers, to keep the candle power of lamps in use on a circuit of a central station at a point which will insure satisfaction or tend to keep the electric light popular is a difficult problem. Whether the customer is on a meter or on a contract basis, it is poor economy for him to keep lamps in his sockets which are giving only 50 per cent. of their initial candle power, but for the corporation which sold him the lamps and supply him with current, to call his attention to the fact that lamps in his sockets are giving only about 8 candles, and attempt to sell him lamps at 50 or 60 cents each, is not likely to bring about the desired result. To meet the above difficulties a number of central stations in different parts of the country are now selling lamps at retail to their customers at cost, and a few stations even below cost, at the same time doing all in their power to prove to them that only by a liberal use of lamps can they obtain the greatest amount of light for a given expenditure of money.

As the profit on the sale of lamps is decidedly a secondary matter as compared with the sale of current and the increased quality of the light, the above plan should commend itself to all central stations not on the basis of furnishing free renewals. It is also worthy of consideration that by adopting this plan the station controls what lamps shall be used on its circuit without dictating to its customers an important point while lamps show such widely different results as those shown by Fig. 1, and while customers continue more likely to believe that the corporation is not supplying proper current than to believe that the quality of lamps they have been purchasing is at fault.

Another method of inducing customers to destroy dim lamps which has found favor with a number of stations, is to make a price for lamps of say 40 cents each and agree with their customers to exchange all dim lamps which they have sold them at half price, that is, for every dim lamp which the customer returns before the carbon is burned out, he receives a new lamp for 20 cents.

Within the last few months the question has often been asked me by central station managers, "What economy of lamps should we use?" This question should, I believe, be settled by central station managers themselves on presentation of facts, they having control of the regulation of their station and knowledge of local conditions.

Fig. 4 shows the same quality of lamp manufacture as Curve No. 2, Fig. 1, and represents 16 candle power lamps started at an initial economy of 4, 3½, 3, and 2½ watts per candle. The accompanying table shows candle power, average candle power, average economy and average candles per electrical horse power at one hundred hour periods in their life.

In considering these curves and table it should be remembered that the result would have been much less favorable to the higher economy lamps had the test been made and curves plotted with a poor quality of lamp, and also that satisfactory results with lamps of higher economy than 3½ watts per candle can only be obtained by exercising the greatest care in maintaining a constant voltage at the lamps. Referring to the table briefly, it will be found that even at six hundred hours lamps of the highest initial economy show the best average result as to average watts per candle and average candles per horse power, and that at nine hundred hours 3 watt lamps show better average results than lamps of 3.6 or 4 watts. The greatest objection which can be urged against the high economy lamp is that while at nine hundred hours the 4 watt lamp reaches a minimum candle power of 13¼ candles and the 3½ watt lamp about 12 candles, the 3 watt lamp reaches 10 candles and the 2½ watt lamp at six hundred hours reaches 8 candles. At the present price of lamps, where fuel is high and the customers' bills are made up on the basis of lamp hours, it would, without question, pay the station to use high economy lamps. breaking them at a point which would insure satisfaction as to average light and keeping the average life comparatively short.

Whatever economy or make of lamp you decide to use, by no means can you so greatly increase the efficiency of your station as by making every possible effort in the direction of maintaining a constant voltage at the lamps. This can only be accomplished and maintained by constant use of reliable portable instruments. No switchboard instrument should be relied on without often checking it by some reliable standard, and it should also be borne in mind that, owing to the varying drop at various loads, constant voltage at the station is just what is not wanted. If you do not possess a reliable portable voltmeter, such an instrument should be your next purchase. Then by constant use on your circuits at different loads, and profiting by the knowledge thus obtained, you would soon find a marked improvement in your lighting and would be in a position to judge which make and what economy of lamp is the best for you to purchase.

		64 Watts	56 Watts	48 Watts	40 Watts
100 Hours	C.P.	17.28	17.44	16.8	16.16
	Average C.P.	16.8	17.06	17.09	16.96
	Average Watts Per Candle	3.9	3.28	2.8	2.36
	Candles Per El.H.P.	191	227	266	316
200 Hours	C.P.	17.12	16.32	15.2	14.08
	Average C.P.	17.03	16.94	16.51	15.97
	Average Watts Per Candle	3.76	3.3	2.9	2.5
	Candles Per El. H. P.	198	226	257	298
300 Hours	C.P.	16.64	15.04	13.92	12
	Average C.P.	16.96	16.53	15.86	14.96
	Average Watts Per Candle	3.77	3.39	3.03	2.07
	Candles Per El. H.P.	198	220	246	279
400 Hours	C.P.	15.68	14.08	12.8	10.56
	Average C.P.	16.74	16.	15.2	14.03
	Average Watts Per Candle	3.82	3.5	3.16	2.85
	Candles Per El. H. P.	195	213	236	262
500 Hours		15	13.28	11.68	9.12
		16.45	15.57	14.62	13.2
		3.89	3.59	3.28	3.03
		192	208	227	246
600 Hours		14.40	12.8	11.04	8.
		16.	15.15	14.08	12.43
		4.	3.7	3.41	3.22
		187	202	219	232
700 Hours		13.92	12.32	10.56	
		15.84	14.78	13.63	
		4.04	3.79	3.52	
		185	197	212	
800 Hours		13.6	12.	10.24	
		15.6	14.45	13.23	
		4.1	3.88	3.62	
		182	192	206	
900 Hours		13.28	11.84	9.92	
		15.36	14.18	12.88	
		4.17	3.94	3.73	
		179	189	200	

Table—Incandescent Lamps; Their Use and Abuse.

Personal.

Mr. B. L. Hawley, of the Union Electric Company of Seattle, who has been spending a few days in the city, has returned to the West.

Association of Edison Illuminating Companies.

The next Convention of the Association of Edison Illuminating Companies will be held at Boston, Mass., commencing on Tuesday, August 14, 1894, and will continue during Wednesday, and probably Thursday, of that week. The following papers of practical importance will be submitted :

Incandescent Lamps—Mr. A. D. Page.

The Relative Advantages of Direct and Alternating Currents for Distribution of Light and Power—Mr. W. S. R. Emmet.

A Board of Control—Prof. Wm. D. Marks.

An Edison Station in a Small City: Its Past, Present and Future—Mr. M. A. Beal.

Switchboard of the Edison Company of New York—Mr. J. Van Vleck.

Storage Batteries—Mr. R. R. Bowker.

Boiler Tests in Atlantic Avenue Station of the Edison Electric Illuminating Company of Boston—Mr. R. S. Hale.

Interesting Features of the Third District Station of the Edison Electric Illuminating Company of Boston—Mr. A. G. Pierce.

Low Tension Arc Street Lighting System—Mr. W. S. Barstow.

The headquarters of the Association will be at the Vendome, one of the largest hotels in this country.

The Edison Electric Illuminating Company of Boston (Mr. C. L. Edgar vice-president and general manager) has arranged a very attractive programme for the entertainment of delegates in the form of drives through the beautiful suburbs of Boston, probably the finest in the world. Visits will also be made to the West End station of the Boston street railway system, and to the various Edison stations in Boston, where can be seen the latest type of central station equipments. including the recently installed central station storage battery, now in successful everyday operation.

NIAGARA FALLS EXCURSION VIA ERIE LINES.

The Erie announces a special excursion to Niagara Falls at half fare ($8.00)—tickets good going on regular trains August 11th, and returning, until August 13th, inclusive.

American Electro-Therapeutic Association.

Following is the preliminary programme of the American Electro-Therapeutic Association, which will hold its fourth annual meeting at the New York Academy of Medicine, New York, September 25th, 26th and 27th :

President's Address—Dr. W. J. Herdman, Ann Arbor, Mich.

THE CONSTANT CURRENT.

Physics: Current Distribution—Mr. W. J. Jenks, New York.

Physiological Effects—Prof. K. E. Dolbear, Boston, Mass.

Therapeutic Uses, General—Dr. A. D. Rockwell, New York.

The Galvanic Current in Catarrhal Affections of the Uterus—Dr. G. Betton Massey, Philadelphia.

Suites e'loignees du traitement electrique conservateur gynæcologie grossesses consecutives—Dr. Georges Apostoli, Paris.

Metallic Electrolysis—Dr. George Gautier, Paris; Dr. W. J. Morton, New York; Dr. Margaret A. Cleaves, New York; Dr. A. H. Goelet, New York.

Treatment of Urethral Stricture (report to date)—Dr. Robt. Newman, New York.

Diseases of the Eye, Electro-Therapeutics of—Dr. L. A. W. Alleman, Brooklyn, N. Y.

Notes on Goitre and Improvements in Apparatus for Treatment of Same—Dr. Chas. H. Dickson, Toronto.

Diseases of the Throat—Dr. D. S. Campbell, Detroit, Mich.

The Action of Electricity on the Sympathetic—Dr. A. D. Rockwell, New York.

Diseases of the Nervous System: The Treatment of Neuritis by the Galvanic and Faradic Currents—Dr. Landon Carter Gray, New York.

Electric Sanitation—Prof. John W. Langley, Ph. D., Cleveland, O.

Physics of the Electric Light in Relation to Organized Matter—Prof. John O. Reed, Ph. M.

Hydro-Electric Methods: Physics and Appliances—Mr. Newman Lawrence, London.

Special Hydro-Electric Applications—Dr. Margaret A. Cleaves, New York.

The Hydro-Electric Therapeutics of the Constant Current—Dr. W. S. Hedley, Brighton, England.

INDUCTION CURRENTS.

Interrupted Currents: Physics, ——.

Physiological Effects—Dr. W. J. Engelmann, St. Louis, Mo.

Therapeutic Uses: General, ——. General Faradization—Dr. A. D. Rockwell, New York; Gynæcological—Dr. A. H. Goelet, New York; Dr. H. E. Hayd, New York; Dr. A. Lapthorn Smith, Montreal.

SINUSOIDAL CURRENT.

Physics—Mr. A. E. Kennelly, F. R. A. S., Philadelphia.

Physiological Effects—Dr. W. J. Herdman, Ann Arbor, Mich.; Dr. J. H. Kellogg, Battle Creek, Mich.

Therapeutic Uses—Dr. Margaret A. Cleaves, New York; Dr. Wm. James Morton, New York; Dr. J. H. Kellogg, Battle Creek, Mich.; Dr. Holford Walker, Toronto; Dr. A. H. Goelet, New York.

Le Courants Alternatifs; leur transformation; leur mesure et leurs applications therapeutiques—Drs. Gautier and Larat, Paris.

On the Sinusoidal Current Method of Regulation, the E. M. F. and Resultant Current—Dr. Lucy Hall-Brown, Brooklyn, N. Y.

STATIC AND STATIC INDUCED.

Physics—Prof. Edwin Houston, Ph. D., Philadelphia.

Physiological Effects, ——

General Therapeutic Uses—Dr. W. J. Morton, New York.

The Treatment of Chorea—Dr. D. R. Brower, Chicago.

Static Induced—Dr. Margaret A. Cleaves, New York.

High Frequency Currents Derived from Static Machines as per Method d'Arsonval—Dr. J. H. Kellogg, Battle Creek, Mich.

IN MEMORIAM.

Dr. Wm. F. Hutchinson, Providence, R. I. Dr. John Chambers, Indianapolis, Ind.; Dr Robt. Newman, New York; Dr. Plymon S. Hayes, Dr. W. J. Headman, Ann Arbor, Mich.

COMMUNICATIONS.

Slightly Inaccurate.

Editor of ELECTRICITY.

DEAR SIR: ELECTRICITY says, July 25, 1894, page 15:

> The Chicago elevated railway contract, widely proclaimed as a million-dollar job, amounts all told to a little less than $300,000. Allowing a profit of 20 per cent., we have in this, the only profitable contract of the year, $60,000 towards repairing the $16,000,000 deficit in the assets of the company.

Mr. Editor, give your estimate clerk a vacation; he is overworked.

The General Electric Company will lose about $20,000 on this contract.

Mr. Baker, the consulting engineer of the Metropolitan L, by the way, is the brother-in-law of Capt. Griffin.

> . . . The abolition of the departments reduces Messrs. W. J. Clarke and J. R. McKee to the ranks, and the latter will probably retire.

No, Mr. Editor, Baby McKee's retirement to his Indianapolis shoeshop will depend upon the next Presidential election. Yours truly,

CRITICUS.

[Our correspondent's figures as to the Chicago contract must be accepted as correct. He knows. ELECTRICITY aims to be fair, and we had made the most liberal allowance possible.—ED.]

THE ELECTRIC FAN MOTOR.

Who Was the Inventor, and What Was the Date?

Dr. Schuyler S. Wheeler recently laid claim in the columns of an esteemed contemporary to the conception of the idea of applying an electric motor to run the miniature ventilating fans, now so common and blessed by all.

Dr. Wheeler does not give the dates of his first experiments, but states that the attachment was first described in a catalogue of the C. & C. Company in 1886.

ELECTRICITY is positive that this date is at least four years too late to establish priority.

There appears to be no doubt that Mr. Edward H. Johnson operated fans on the small motors made by the Edison Company as early as 1882. There are several old Edison men who can easily verify this, and we would like to hear from them or from any one else who can establish prior claim.

In reply to a recent inquiry, Mr. Johnson says:

MY DEAR GREENE: I always thought I was the first one to do this, and I think so yet. I note that Prof. Wheeler does not give his dates. I give you mine. I have always regretted that I appreciated the thing so little at the time as to not think it worth a patent. I have received the following from Mr. Bergmann.

Yours, etc., E. H. JOHNSON.

New York, July 20, 1894.

MY DEAR JOHNSON: In reply to yours of the 24th, as to about when you put a fan direct on the axles of the little motors we manufactured at 17th street, would say that it was in the winter of 1882-'83. You can find out by looking at some of our old catalogues in which these motors were advertised, but of course this would naturally be later than your experiments.

I hope this information will be satisfactory, and remain yours truly,

S. BERGMANN.

It is time we all knew whom to thank for the simple device which blows us off at the rate of forty miles and one cent per hour.

Are there any Goebels in the field?

The Ries Electric Specialty Company of Baltimore, Md., has gone into the hands of a receiver. The company was incorporated June 16, 1890, and has been engaged in the manufacture and sale of several specialties of considerable merit. The failure of the company is no doubt largely due to incompetent business management, and to their failure to advertise their goods properly.

Trolley Parties.

In rural towns, and indeed in some places not truly rural, the electric railway is becoming popular as a means of enjoyment. Excursion parties on the trolley roads are noted in the country papers with great gusto, and in many cases the names of the participants are spread out to as great a length as the list of attendants at a metropolitan fashionable hop. A Paterson paper supplies the following, which may stand for a host of others to be found in our rural papers: "'Trolley parties' were all the go last night and it seemed as if the population, especially the female portion, spent the greater part of the night on the open cars of the various electric lines. The 'merry-go-round' and Passaic routes of the Paterson company were the most popular, a regular procession of motors and trailers filled with white and pink-gowned and hatless members of the gentler persuasion passing along the tracks, while the handsome cars of the Rutherford and Little Falls lines were packed with persons who wooed the cooling breezes on the hills and dells of those romantic routes. The trolley companies reaped a rich harvest of nickels."

Another example: "The trolley party given in honor of Mrs. H. C. Conrad, by Dr. and Mrs. C. H. Harry, which took place yesterday, was in every respect a novel and enjoyable mode of spending a warm evening. The guests assembled at No. 1004 DeKalb street at 7 P. M. and boarded the 'special,' in charge of Motorman Joseph Golden and Conductor Charles Commerford, a half hour later. En route, 'ice water, pretzels and peanuts' were served, and on the return of the party, after two entire rounds over the road, refreshments of a more appetizing nature were enjoyed at the home of the host. On the second round, in passing the residence of Mr. W. Potts, that gentleman signified his delight by exploding 'an entire pack of fire crackers.' The party returned to the starting point at half-past 9 o'clock, having made the double trip in just about two hours. Superintendent Passmore accompanied the car and made all the arrangements for an uninterrupted passage without interfering with the regular schedule. The affair was such a success that another by different parties is in course of preparation, to take place at an early day." A list of the participants, containing about thirty-five names, is appended to the account.

Private Electric Lighting.

Electric engineers are often asked by the owners of large establishments to advise them whether it will be more economical to lay down their own lighting plant or to buy energy from a supply company. This, opines *Engineering*, is a difficult question to answer, seeing that the reply must be founded upon assumptions many of which are more or less hypothetical. For example, the apparent cost of working a private installation depends greatly on the system of bookkeeping adopted. A pedantic accountant will charge against the account every possible item he can think of. Not only will he include labor, coal, stores, interest, depreciation, rent and taxes, but also a share of his own salary, and of that of clerks, managers, foremen and watchman and a proportion of the fire insurance. Another man will not only ignore these latter small matters, but he will also take no account of rent and taxes, on the ground that these have not been increased, nor the facilities of the establishment diminished, by the erection of the plant in an odd corner of the basement. Quite a sensible difference in the apparent cost per unit can be made by variations in the method of book-keeping.—*The Electrician.*

Our contemporary has placed the case very well. It is very difficult to get figures that are reliable upon private plants, the method of bookkeeping being the point on which we have to split. As the writer says, it depends very largely on the bookkeeper whether we figure out a profit or loss. We believe, however, that with gas or gasoline engines the individual can supply himself with light at less cost than the company that has to transmit the energy from a distance. What we want is agents who will treat an inquirer as a gentleman. We certainly need this in the United States.

FOREIGN NOTES.

The Photogene is one of the latest novelties described in the French technical papers. It is the invention of Mr. Barrnet. It is said that the inventor, by the aid of his photogene and accessory clockwork mechanism, can charge successively, and without any interruption, the cells forming a battery of accumulators, which can at any time energize incandescent lamps and even one or two arc lamps. The photogene is a sulphate of copper battery which is automatically maintained. The E. M. F. of the photogene, which according to its size gives constantly from six to twelve amperes, is equal to one volt per cell. Several small installations on this system are said to have been in operation for two years, supplying lamps from 5 c. p. to 16 c. p. of 24, 36 or 48 volts. The cost per kilowatt-hour is greater than that incidental to dynamos.

The London *Electrician* says: "The transformers at the power transmission plant of the Oerlikon Electrical Works are interesting from the fact of their having an oil circulation. Taking the average load on each transformer as 170 kilowatts, and allowing a loss in conversion of 2 per cent., some 3.4 kilowatts is being lost, appearing as heat. In order to dissipate this heat, the oil is circulated through serpentine tubes immersed in a tank through which there is a constant flow of cold water. The circulation is effected by means of a pump." Our contemporary should have given credit to Prof. Henry Rowland, an American, who first invented transformers of this type

An eminent German scientist, Prof. Kohlrausch, has made experiments with the purest water which he could obtain, and finds that a column of one inch has a resistance equal to a copper wire of the same cross-section passing twenty-five thousand times around the earth.

Lord Kelvin has been awarded the Grand Médaille of the Société d'Encouragement pour l'Industrie Nationale of Paris, in recognition of his scientific work.

The committee of French civil engineers selected to fix a subject for competition for the Gifiard prize in 1895 have fixed upon the following: "Transmission of power by means of electricity, either to machine tools in a workshop, or to the machinery of a railway or tramway line, or to the apparatus of a bridge, ship, dock, or public works." The competitor is to commence his paper by a summary of what has been done in the branch which he selects, following it by a description of work executed or a project capable of being carried out. The value of the prize next year will be £240.

Mr. Alex. Siemens of the English house of Siemens & Halske has submitted an offer to the Canadian Government for laying a cable under the Pacific Ocean from Victoria, British Columbia, to Sydney, New South Wales. He undertakes to complete the construction within three years.

The Chambly Manufacturing Company of Montreal, Canada, is inviting tenders for the development of the water power at the Chambly Rapids of the Richelieu River, the outlet of Lake Champlain, and its conversion into electricity and transmission to the city of Montreal, a distance of about 18 miles. The company has secured control of the entire water power at the rapids, which have a fall of 62 feet in a distance of four miles. To fully utilize the power, a series of dams would have to be built across the river; but at present the building of one only is contemplated. According to the company's engineers, this would give a head of from 26 to 27 feet, and yield about 27,000 horse-power at low water. Some 15,000 H. P. would probably be delivered in Montreal; of which about 3,000 H. P. would be used for arc lighting, 6,000 H. P. for incandescent lighting, and 6,000 for power purposes. According to the engineers who have been consulted, ice in winter will not interfere with the working of the water-wheels, which has been found to be a fatal objection to the utilization of the power of the Lachine Rapids of the St. Lawrence River, which are located but five or six miles from Montreal.

General News.

What is Going on in the Electrical World.

Kansas City, Mo.—The dummy line to Independence is to be changed to an electric line this fall.

Lockport, N. Y.—Quincy G. T. Parker has petitioned the common council for a franchise to operate an electric street railway here.

Vallejo, Cal.—The electric light works were totally destroyed by fire recently. The plant had been in the hands of the sheriff for some months.

Savannah, Ga.—The City and Suburban Railway Company has reduced the fare on its line to to one cent, in continuation of the street railway war.

Perry, Iowa.—The electric light and water-works power house has been demolished by the explosion of one of the boilers. The entire plant is a complete loss.

Chicago.—The West Chicago Street Railway Company has been granted a permit to change its horse car line in Van Buren street to the overhead trolley system.

Waterbury, Conn.—The electric road of the Waterbury Traction Company, connecting this city with Naugatuck, was opened for traffic last week. The road is five miles long.

Toledo, Ohio.—The Electric Installment Company of Chicago has closed a contract with the board of directors for electrically lighting the Exposition which opens here on the 20th inst.

Los Angeles, Cal.—The board of supervisors have repealed the franchise granted some months ago to C. S. Strange and others for an electric road between Los Angeles and Pasadena.

Marlboro, Mass.—At a special meeting of the aldermen last week the location of the proposed electric railroad between this city and Hudson was defined and the franchise for the road granted.

Lansing, Mich.—The Capitol is lighted at present partly with gas and in part with electricity, but a proposition will be submitted by the electric light and water commission to light it wholly with electricity.

Yonkers, N. Y.—The common council has granted a franchise to the North and South Electric Railway Company to operate a trolley road through certain streets to Tuckahoe. The company will begin work at once.

Minneapolis, Minn.—The decision of the Supreme Court upholds this city in its suit to set aside the five-year contract with the Minneapolis General Electric Company for lighting the streets, and the city is now free to erect a lighting plant.

Newark, N. J.—An experiment was made by the Consolidated Traction Company a few evenings since which is of interest as showing what may be possible in the propulsion of cars by electricity Upon an unobstructed portion of the line between Newark and Jersey City a car was propelled, it is said, at the rate of forty-five miles an hour.

Hazleton, Pa.—A Wilkesbarre paper says: "A New York brokerage firm has issued prospectuses for the promotion of an electric railway company to operate between Nanticoke and Berwick. The intention is to extend the line to Hazleton. The projectors expect to bond the road for $1,500,000. The company expects to build twenty-three miles of road. The Johnsons, of Cleveland, are said to be back of the enterprise."

Philadelphia, Pa.—A system of telephone communication is being established between the post-office and all of the sub-postal stations here, and workmen are busy putting in the phones and laying the wires. The phones will facilitate communication between the office of the superintendent of city delivery and the sub stations, and when in operation are expected to aid greatly in the expeditious delivery of mail matter.

Alameda, Cal.—Tucker & Steck, of San Francisco, have petitioned the city trustees for a franchise for thirty years to run an electric light and power plant. The city owns an arc light plant and illuminates the streets at night. It costs about $1,000 a month to do this. The merchants desire incandescent lights in their stores and the city cannot furnish them. Hence the citizens are anxious that the trustees give some one a franchise to furnish light.

St. Louis.—The Southern Electric Railway Company's additional franchise, which enables it to abandon its present terminus at Sixth and Market sts., and run its cars on a loop around the Union Market, in the heart of the city, will, it is said, cost the company $10,000 a year, but will add half a million to the value of the property. It is thought likely that the stock will be purchased by St. Louis capitalists. It is now principally owned in Louisville, Ky., and Cleveland, Ohio.

Fitchburg, Mass.—The Fitchburg and Leominster Street Railway Company's new power station at South Fitchburg, has been completed, and the company has discontinued receiving power from the electric station at Leominster. The new plant is of the most approved kind throughout. The generators, of the Westinghouse make, are directly connected with the engines without the use of belts and pulleys. The power station and equipment cost $60,000.

Cincinnati.—The Dewey Electric Heating Company, a West Virginia corporation, with its principal office in Boston, Mass., has sued the Cincinnati Street Railway and John Kilgour in the U. S. Circuit Court of this district for using a car-heating apparatus averred to be an infringement on the Mark W. Dewey patent.—Parties representing an English syndicate are in the city seeking investments in electrical lines, and are looking over the field of the Cincinnati, Middletown and Dayton line and that of the proposed Columbus Springfield-Cincinnati line. They control the patent on a storage battery that they believe is the solution of the vexed electrical problem and will test it on the heavy street grades of this city. It is claimed that this battery is equal to an inclined plane in which the inclination is one foot in six. The test will be made soon and if they find their battery to be all that is claimed for it they propose to introduce it here if they have to build a line on which to put it in operation.

Baltimore, Md.—The Randallstown, Harrisonville and Granite Rapid Transit Company will reorganize under the same name and have arranged with the representatives of the Barrow Electric Railway system to co-operate with them in building the proposed single rail line between Pikesville and Randallstown.—The Traction Company has completed its Edmondson avenue electric line to Payson street, and in a few days the road will be in operation to Walbrook.—The Chevy Chase and Kensington Railway Company has been organized to construct an electric railway from the present terminus of the Rock Creek Railway to Kensington. The officers are: President, Mr. Oliver R. Harr; vice-president, Mr. Alfred Ray; secretary and treasurer, Mr. W. H. Walker; directors, Messrs. Redford W. Walker, Robert B. Detrick, Augustus Burgdorf, O. R. Harr, W. H. Walker, Alfred Ray, Thomas R. Martin, William H. Mannakee, Alfonso Hart, Alexander M. Proctor and C. Parker Jones.—Judge Ritchie has appointed Bernard Weisenfeld and Sylvan H. Laucheimer receivers to take charge of and wind up the affairs of the Reis Electric Specialty Company. The company was incorporated June 16, 1890, by Elias E. Reis, Lewis S. Greene der, Leopold Reis, Dave Myers and O. Milton Dennis. The capital stock was placed at $25,000 The corporation was engaged in the manufacture of electric specialties and novelties in this city.

Large Electric Railway Plant.

The tendency for very large electric direct coupled generators, especially for railway power plants, has been illustrated again in a contract just closed between the West Chicago Street Railway Co. and the Siemens & Halske Electric Co. of America, for three 2,000 horse-power and one 1,000 horse power generators. The Chicago *Tribune* says:

"The station is to be located on the property of the company at Washington boulevard and Western avenue. The company's repair shops and stables are located there, and it is considered that the situation is particularly convenient for an electric power station because of the central location in the territory which is to be served. The station which will be constructed there is intended to ultimately accommodate five 2,000 horse-power generators and one 1,000 horse-power. This station, with its total capacity of 11,000 horse-power, will be the second largest in the country, and it will be capable of moving 500 cars.

"Work is to begin on Van Buren street immediately. The line will have to be entirely rebuilt. About three miles of street will be converted into electric line, the cars being taken at Halsted street and connected with cable. The motor cars will be hitched on to the cable so that there will be no delay in making connections. Mr. Chapman has devised a scheme for disconnecting the electric machinery in the motor car while the train is being drawn by the cable. The bids for the electric machinery, which were opened yesterday, called for the completion of the first dynamo within four months of the award of the contract. The contract calls for the completion of an additional machine every fifteen days. The contract for the engines will be let immediately. The West side power system is ultimately intended to operate electric lines on sixty miles of street, and the West Side company contemplate converting 120 miles of horse car lines into electric lines.

"The contracts for the construction of the North Side power-house and for the engines and machinery were let Monday. The power-house will be located on the river opposite Sharpshooters' Park at California avenue and Roscoe boulevard. The station will ultimately take in generators aggregating 6,000 horse-power. At present it is only the intention to operate 135 cars from that station, and the contracts which were let Monday called for generators aggregating 2,800 horse-power. Contracts for the engines were let to the Fraser-Chalmers Company and for the electrical machinery to the Siemens & Halske Electric Company of America. The generators at the North Side station are intended to operate both North and West Side lines. The territory which will be covered will embrace all the lines of the North Chicago Street Railroad Company, and will also furnish power for all the West Side lines north of North avenue. Power will also be furnished for a new line which is to be constructed on Elston avenue from Chicago avenue northwest. This Elston avenue line is being built by the Chicago Electric Transit Company, a corporation that obtained an ordinance some two years ago. At present there is supposed to be no direct connection between that company and either the North Side or West Side companies, but it is intimated that ultimately the West Side Company will absorb that property. The entire electrical plants of the two street railroad companies embrace double tracks on 100 miles of street. It is expected that the first electric cars will be in operation early next year, and others will be rapidly equipped after that. The cross-town lines can be got ready to operate by electricity rapidly, for they will not have to be rebuilt. All lines laid within the last year or two were put down with the intention of changing them from horse to electric, and nothing will be necessary but to string the trolley wires."

The Siemens & Halske Electric Company of America, who for the last two years have been the most prominent advocates of large direct-coupled units both for lighting and power service, are to be congratulated on their success.

The following list of railway plants, erected or under construction, speaks for itself:

LIST OF SIEMENS & HALSKE DIRECT-COUPLED RAILWAY GENERATORS IN THE UNITED STATES AND CANADA.

	Total Electrical H. P.
Garden City Construction Co. Chicago, four 620 H. P. generators	2,480
West Chicago Street Railway Co., Chicago, three 2,000 H. P. generators, one 1,000 H. P. generator	7,000
Johnson & Edwards, contractors for Nassau Electric Railway Co., Brooklyn, N. Y., three 667 H. P. generators	2,000
Toronto Street Railway Co., Toronto, two 1,400 H. P. generators	2,800
City Railway Co., Dayton, Ohio, three 400 H. P. generators	1,200
Ringing Rocks Street Railway Co., Pottstown, Pa., two 135 H. P. generators	270
Cincinnati Street Railway Co., Cincinnati, Ohio, one 650 H. P. generator	650
Total	16,400

The above table gives the *rated* capacity of these generators only, while those that have been in actual service have shown their capacity to stand an overload of 50 per cent. for hours, without harm or flashing on the brushes.

With almost fifty years' experience of the parent German company as a backing, the excellent results obtained by the American youngster in so short a period, of course, should not be surprising.

Waddell-Entz Apparatus.

Clients and friends of the well-known Waddell-Entz apparatus will be glad to learn that arrangements have been perfected by which the manufacture of the Waddell-Entz dynamos and motors will be carried on with improved manufacturing facilities and on a more extensive scale than formerly. The machines will be built in Bridgeport, Conn., in a new shop fully equipped with the most improved tools and machinery, overhead traveling crane, etc., and the most ample facilities for turning out the highest class of mechanical work with promptness and dispatch.

Mr. Waddell still retains his connection with the enterprise, and the sales department will be in charge of Mr. J. A. Machado, who has been connected with the Waddell-

Entz Company since its organization. Correspondence and inquiries should be addressed to J. A. Machado, Agent, 203 Broadway, Mail and Express Building, New York City.

Slow Speed Motor of the Mather Electric Company.

The Mather Electric Company is calling attention to its Manchester type slow speed motor, an illustration of which is presented in Fig. 1. The fields are of cast steel, while the base, sub base, etc., are of cast iron, thus making the motor of particularly light weight for the output. The field coils are wound on metal bobbins, perfectly insulated, and can be slipped on and off the field magnet with ease. The bearings are of the Mather Company's improved self-oiling type, with composition bushings. The armature, Fig. 2, which is exceedingly large, is of the iron clad slotted type and of the modified Siemens winding, insuring slow speed. Great care is taken in building it up. The shaft, which is very large in diameter, is of the best machinery steel; the core is of sheet iron disks, which, by an improved annealing process, together with a proper insulation of wire, does away with destructive heating. The insulation throughout is of the best obtainable, mica being used exclusively. All armatures are carefully balanced before being sent out, and, the company claims, will operate without vibration. The commutator is of improved design, exceedingly massive and carefully insulated. Every part of the Manchester type slow speed electric motor is made to jigs and templets and can be duplicated at once from stock.

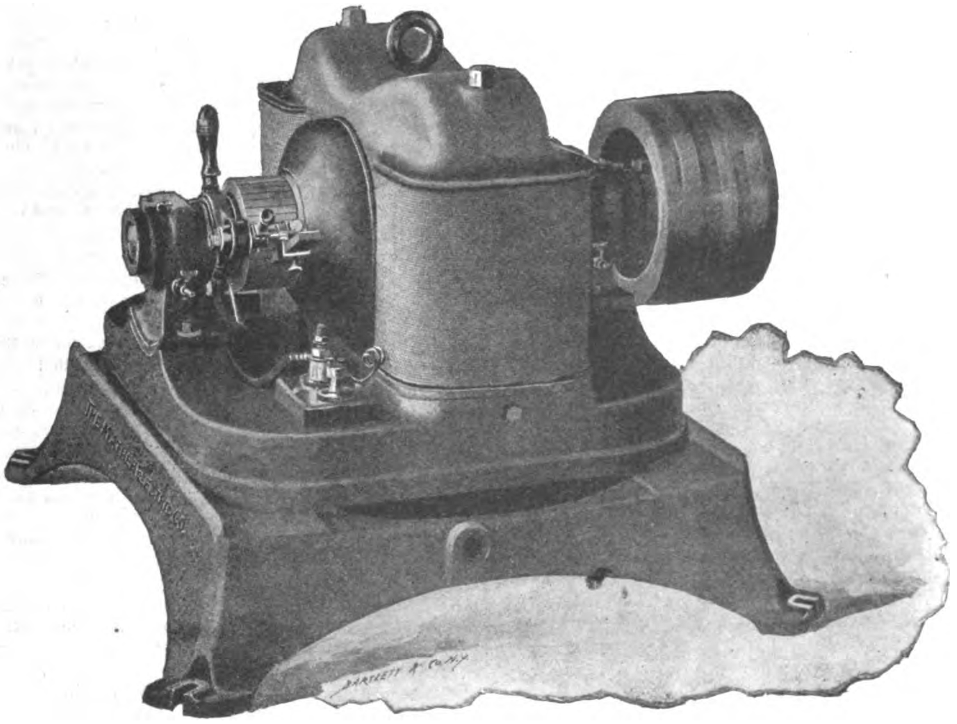
BARTLETT & CO. N.Y.

FIG. 1.—MATHER SLOW SPEED MOTOR.

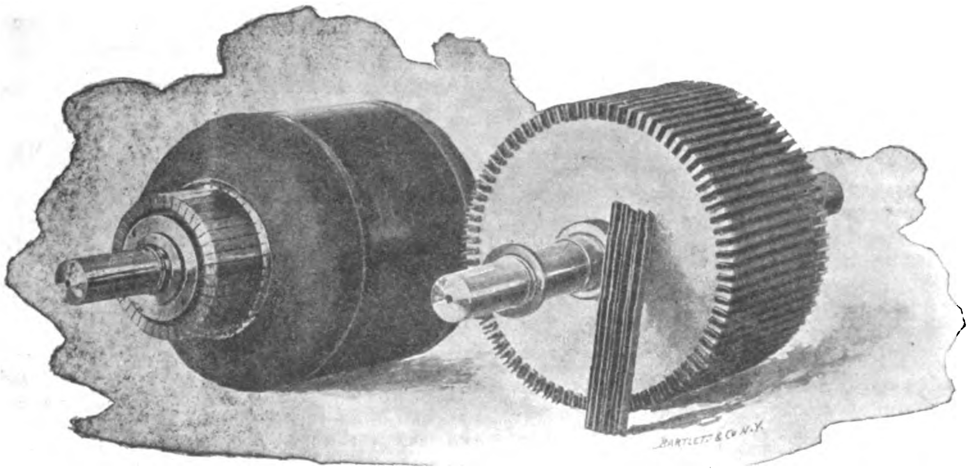
BARTLETT & CO. N.Y.

FIG. 2.—ARMATURE, MATHER SLOW SPEED MOTOR.

A Large Alternator.

At the works of the Fort Wayne Electric Corporation there is running and being tested to-day a new alternating current dynamo. This dynamo is the last of a series of iron-clad alternators designed by Mr. James J. Wood, the company's electrician. This alternator has the largest capacity of any single armature compound wound alternator ever constructed in this country, having one-fifth larger capacity than the big alternators exhibited at the Chicago Exhibition. The machine from the first has worked beautifully, and in every particular more than meeting the expectation of the designer, and so far as the workmanship is concerned, which is of the highest possible character, it reflects great credit upon the ability of the workmen who constructed it. The design is beautifully artistic, embodying all the beautiful lines and curves exhibited in all Mr. Wood's apparatus, while the efficiency is considerably over 90 per cent. Judging from the operation of this alternator during the test, the company predict a great future for it, believing that no person could see it work without being favorably impressed by its operation.

It is capable of operating 6,000 16 candle-power lights, and some idea of its size will be realized from the following dimensions:

It is 16 feet long, 8 feet wide and 10 feet high, while it weighs 31,000 pounds, producing a current of 150 amperes at 2,200 volts, requiring an engine of 600 horse-power to drive it.

Schoonmaker's India Mica on the Pacific Coast.

Roger & Atwater, 214 Pine street, San Francisco, have taken the agency for the Pacific Coast for A. O. Schoonmaker, 158 William street, N. Y. They carry a full line of India Mica, cut, uncut and stamped for segments and rheostats, and can fill orders promptly and at lowest price.

INCORPORATIONS.

The Cohoes City Railroad Company—to construct a street surface electric railroad in Cohoes about five miles long. Capital stock, $50,000. Directors: Urban Weldon, Murray Hubbard, E. W. Lansing, George E. Simmons, John Carside, Herman Kohn, Thomas O'Dea and Hugh Graham, of Cohoes, and J. W. Himes, of Waterford.

The Sturgeon Bay Waterworks and Electric Light Company, Sturgeon Bay, Wis.—to furnish electric light and power. Capital stock, $35,000. Promoters: L. M. Washburn, Thomas H. Smith, W. J. Binks and W. A. Lawrence.

The Citizens' Electric Light and Power Company, Appleton, Wis.—to transmit electric light and power. Capital stock, $10,000. Promoters: M. H. Croswell, A. C. Langstadt and John A. Paterson.

The Arkansas Valley Electric Company, Denver, Col.—to furnish electricity for light, heat and power to the town of Florence, Fremont County, Col. Promoters: J. W. Stearns, Jr., George A. Goddard and James E. Johnson, Denver.

The stockholders of the State Electric Light and Power Company of Brooklyn, N. Y., have voted to increase the capital stock of the company from $200,000 to $500,000.

The Belding Electric Alarm Mail-Box Company, at Chicago. Capital stock, $100,000. Incorporators: Edward C. T. Belding, Thomas W. Saunders and C. Stuart Beattie.

The Cleveland General Electric Company, Cleveland, O., has officially changed its name to the Cleveland Illuminating Company.

The Fort Plain and Richfield Springs Railway Company—to build, maintain and operate a standard gauge railway between Fort Plain and Richfield Springs, N. Y., to be operated by steam or other mechanical power. Capital stock, $300,000. Directors: William Clark, Fort Plain, N. Y.; Norman Getman, Elias B. Wetherbee, Myron A. McKee, Richfield Springs, N. Y.; John D. Wendell, Willis E. Diefendorf, David G. Hackney, Fort Plain, N. Y.; Stephen R. Stewart, Springfield Center; Edwin S. Van Deusen, Fort Plain, N. Y. The principal office will be at Fort Plain.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JULY 31, 1894.

ELECTRIC RAILROADS AND APPLIANCES.

523,653. Insulating-Block. Henry P. Ball, Bridgeport, Conn., assignor to the General Electric Company of New York. Filed May 21, 1894.

ELECTRIC LIGHTS AND APPLIANCES.

523,893. Bushing for Electric-Arc Lamps. Thomas J. Houck, Baltimore, Md., assignor of one-half to James Frank Morrison, same place. Filed April 23, 1894.

MOTORS, DYNAMOS, ETC.

523,663. Commutator for Dynamo-Electric Machines. Joseph Hoffman, Schenectady, N. Y., assignor to the General Electric Company, Boston, Mass. Filed Dec. 21, 1893.

523,668. Dynamo-Electric Machine or Motor. Walter H. Knight, Lynn, assignor to the General Electric Company, Boston, Mass. Filed Jan. 9, 1894.

523,685. Armature for Dynamo-Electric Machines. Henry G. Reist, Lynn, assignor to the General Electric Company, Boston, Mass. Filed Sept. 15, 1893.

523,696. Dynamo-Electric Machine. Elihu Thomson, Swampscott, assignor to the General Electric Company, Boston, Mass. Filed March 19, 1894.

523,776. Armature for Dynamo Electric Machines. Horace F. Parshall, Lynn, assignor to the Thomson-Houston Electric Company, Boston, Mass. Filed Jan. 31, 1894.

523,779. Alternating-Current Generator. Edwin W. Rice, Jr., Swampscott, assignor to the General Electric Company, Boston, Mass. Filed July 25, 1893.

523,822. Electromagnetic Reciprocating Pump. Charles J. Van Depoele, Lynn, Mass., C. A. Coffin and Albert Wahl, administrators of said Van Depoele, deceased, assignors to the Thomson-Houston Electric Company, Boston, Mass. Filed Dec. 12, 1891.

523,957. Electric Welding or Brazing Mechanism. George D. Burton, Boston, Mass. Filed June 8, 1893.

TELEPHONE AND TELEGRAPH APPARATUS.

523,927. Magnetic Telephone. Frederick H. Brown, Chicago, Ill. Filed Nov. 25, 1893.

BATTERIES.

523,689. Process of Making Secondary Battery Plates. William L. Silvey, Dayton, Ohio. Filed Sept. 22, 1892.

523,892. Galvanic Element. Albrecht Heil, Crumbach, Germany. Filed Sept. 27, 1893.

523,949. Method of Making Stiffened Connectors for Secondary-Battery Plates. William E. Silvey, Dayton, Ohio. Filed Aug. 28, 1893.

SIGNALS AND SIGNALING APPARATUS.

523,723. Railway-Signal. Frank E. Kinsman, Plainfield, N. J. Filed Feb. 1, 1893.

523,767. Electric Signal for Railways. Charles A. Hammond, Boston, Mass. Filed April 12, 1894.

523,798. Means for Testing Electric Signal-Boxes. Jacob F. Mehren, Chicago, Ill. Filed Nov. 24, 1893.

523,847. Electric Signaling Apparatus for Railway Trains William H. Baker, Pawtucket, R. I. Filed May 31, 1894.

MISCELLANEOUS.

523,662. Electric Meter. Eugen Hartmann, Frankfort-on-the-Main, assignor to Hartmann & Braun, Bockenheim near Frankfort-on-the-Main, Germany. Filed March 23, 1893.

523,695. Electro-Expansion Device. Elihu Thomson, Lynn, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Nov. 25, 1887.

523,701. Automatic Circuit Closer. Joel W. White, Providence, R. I., assignor of one-half to Ashbel T. Wall and George A. Wall. Filed March 11, 1893.

523,704. Electric Meter. Thomas Duncan, Fort Wayne, Ind. Filed March 14, 1894.

523,724. Electric Switch. George E. Linton, Worcester, Mass. Filed March 22, 1894.

523,748. Coin-Controlled Phonograph. Thomas H. Macdonald, Bridgeport, Conn. Filed Dec. 31, 1891.

523,805. Electric Converter. John A. Cabot, Cincinnati, Ohio, assignor of two-thirds to Frank H. Kirchner and Henry M. Ziegler, same place. Filed Sept. 22, 1893.

523,836. Art of Making Electrotypes. Albert W. Harrison, Baltimore, Md. Filed March 11, 1892.

523,865. Testing Device for Electric Circuits. George A. O'Neill, Boston, Mass. Filed Oct. 20, 1893.

523,889. Automatic Line Discharger. Jacinto F. Ganduxer, Gracia, Spain. Filed Nov. 4, 1892.

RE-ISSUE.

11,433. Electric-Arc Lamp. Joseph B. McKeown, Cleveland, Ohio. Filed May 22, 1894. Original No. 519,045, dated May 1, 1894.

DESIGN.

23,528. Electric-Heater Case. Mark W. Dewey, Syracuse, N. Y. Filed June 15, 1894. Term of patent 14 years.

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EDITORIAL NOTES.

WHAT HAVE THE LICENSEES TO GAIN?

The Association of Edison Illuminating Companies meets this week in annual convention in the City of Boston. The programme is an interesting one, and the papers cannot fail to impart needed practical information to the members of the most progressive body of Central Station men in the world.

Though nothing of the kind is down on the programme, there is likely to be lively discussion of purely business matters, which are really of far greater importance to the Edison Association to-day than the technical or scientific subjects with which the prepared papers will deal.

The question of supreme importance to them just now is, WHAT HAVE THE MEMBERS OF THE ASSOCIATION OF EDISON ILLUMINATING COMPANIES TO GAIN BY THE CONTINUANCE OF THEIR LICENSEE RELATIONS WITH THE GENERAL ELECTRIC COMPANY?

This question has been in the minds of the more thoughtful members for about two years. It has been informally discussed whenever they have got together, and has been the subject of formal debate in the meetings of the Executive Committee. It is a question which was never raised while the successive Edison manufacturing companies maintained a separate existence. Then there was a unity of interest between the parent and the licensed companies which was self-evident and potent in the prevention of any serious disputes. The Edisonian interest was on one side, with all other elements in the trade working in opposition, and through various trades and deals and working arrangements exerting their power in more or less accord against the Edison Company.

The Association of Edison Illuminating Companies originated in an appreciation of these conditions. The objects of the Association were no less the instruction of the members and the interchange of views on station management than the formation of an organized commercial body to protect and advance the business interests of the Edison station men and the parent Edison Company. The Association had from the start the full support of the parent company, and there were never any serious differences of opinion or policy. Perfect good faith between the two elements was proven by the election of various employees of the parent company as officers of the Association. There was nothing strange about this, as there was every reason why there should be perfect harmony.

The Licensee plan was a good one, and the fiasco which has resulted through the attempted amalgamation of interests impossible of assimilation should not blind our eyes to the many strong and few weak points in the scheme. The sustainment of the leading Edison patents would have made of the Edisonian industry the most successful business enterprise of the century, and the Licensee arrangements would have been at once the foundation and the keystone.

Considering briefly the subject as it appeared in the beginning of the lighting business, infinite credit is due to Mr. Edward H. Johnson, the originator of the plan; granted faith in the Edison patents and no plan could have been devised with greater possibilities; and no man ever had stronger faith in these Edison patents than Mr. Johnson. Whether their establishment was ever among the possibilities or not must remain a mooted question. Certain it is they have not been established, and can not be established now, the more important ones expiring within the next few months. Thus the Licensees, instead of buying membership in an invincible combination, have found the Edison rights of only fair value at any time; and whatever value they may have had will soon vanish. They have paid a high price for paper rights. Now they find themselves confronted with a new situation, and one fraught with dangers to the prosperity of their business, the profitableness of their respective investments.

This would not have been the case but for the unfortunate organization of the General Electric Company. As we have said, the establishment of the patents on which the Edison Licensees went into business would have made them supreme in their territories and would in turn have made marvelous success for the parent company. Just who was responsible for the delay in pushing patent suits on the part of the Edison Electric Light Company has never been made sufficiently clear. It must come out at an early day in the suits which the Licensees will need to bring to cancel their obligations to deliver the stipulated percentage of increases in capital stock. ELECTRICITY has always supposed that Mr. Edison himself was the individual responsible for the tardiness in pushing these patent suits to issue. But, however this may be, whoever the individual was whose judgment and foresight were so faulty, the policy became the official one of the company, and the latter cannot evade its responsibility to the Licensees for having sold goods which have never been delivered in the way of guarantees of exclusive right;—the question would scarcely be a debatable one in a court of law.

Even without the establishment of the patents, moreover, the Licensee arrangements were fairly profitable to both parent company and Licensees under the Edison regime. The parent company had a sure and fixed trade from the Licensees large enough to have made the payment of dividends on a reasonable capitalization possible for many years to come. With correct management, even without the establishment of the patents, the Edison General Company could have reaped a handsome return, and the Licensees would have had many advantages over present or intending competitors. Though not large enough to warrant the payment of so large a price as one-third of the capital stock of each individual company, these advantages were of great importance. The Licensees had, by virtue of their contracts, substantial discounts on all apparatus and supplies bought of the parent company. They were, moreover, for a few years after Mr. Edward Weston retired from the United States Company, in no immediate danger of effective competition in the incandescent branch in their respective territories. They were sure, for a period covering several years, of practical monopoly even without the patent rights. Their commercial position was a good one, through valuable franchises, and was becoming stronger every year.

In addition to this, and of fully as much importance in strengthening their hold on the business, they had the full benefit of the continued and valuable improvements made by the corps of Edisonian engineers and technical men—a group of the ablest and best equipped technical and practical men ever gathered together in the service of one company in this or any other country. They were pioneers in the business, were well paid, satisfied with their positions, and worked with an energy and an enthusiasm which were more than admirable. They are well known, and to name a dozen of them would be an easy matter. The results of their work, the best of the period, were promptly taken advantage of by the Edison Licensees, who were kept in the front rank of progression in the art and in practical central station work. Thus they received for a long time, if not full value for their surrendered stock, at least good interest on this part of their investment.

We believe we are well within the facts when we assert that the Edisonian enterprise, without sustained patents, previous to the General Electric consolidation, had in it the possibilities of practical and solid success for both itself and its Licensees, and that good reason existed for a continuance of the Licensee arrangements.

With the formation of the General Electric Company, controlled by the unchangeable enemies of the Edison enterprise, the entire situation changed in an hour. From the moment that this consolidation was arranged at Henry Villard's house, up the Hudson, every interest of the General Electric Company has been in direct conflict with the interests of the Edison Licensees.

The first thought of the Boston management was to force consolidations in every town and city where there were Edison and T.-H. stations. That this was not successful is well known, as are the reasons why it was not successful. Following this there has been a continued and persistent, though generally secret, effort made to weaken the position of the Licensees in every possible manner.

As the case stands to-day, if there is one reason for the continuance of the Licensee relations it is not apparent to the most careful students of the situation, those most familiar with the Licensee question.

Looking at the reasons heretofore enumerated why the Licensee arrangements were valuable to the Licensees in the days of the Edison General Company, one by one we find they have utterly disappeared.

First, and of most importance, the benefits derived from the work of a corps of able scientific and practical men employed by the parent company. The Edisonian army has been scattered to the four winds. The young men whose work made the company and the Edisonian industry are giving the benefit of their knowledge and experience to other and varied enterprises. Many are with competing manufacturing companies, many (as Johnson, Leonard, Andrews, Vail, Sargeant, Field and Steiringer) are in business for themselves, and others (as Edgar and Barstow) are in charge of Licensee stations. None of these are in sympathy with the parent company. Thus the Edison Licensees find themselves tied up to a manufacturing company which has fallen behind in the race in the past two years, and must fall behind much faster in the next two. *There is not in the employ of the General Electric Company to-day one man who is competent to install a station on the Edison three-wire underground system.* The Edison army is not dead, but no member of it, save John Kreusi, is to be found at Broad street, at Schenectady or at Lynn.

Taking the question of prices, we find the old-time advantage absolutely wiped out, the rights of the Licensees ignored. Incandescent lamps, the price on which was cut by an idiotic policy to a point leaving no profit for any one, are being sold to large individual users at 24 cents, which is, we believe, the lowest price to Licensees. The same applies to supplies of all other kinds.

In the matter of generators the price is actually lower to outside purchasers than to Licensees. A sale was recently made of 200 K. W. machines at a trifle over $1,500, or less than $7.75 per K. W. What Edison Licensee has bought its machines at this figure, or anywhere near it? The figure here mentioned was an extreme one and certainly below shop cost. They were belted machines.

But in the matter of direct connected multipolar machines, in which the Licensees have more interest, the bids of the General Electric Company on twelve recent contracts show an average of less than $15 per K. W. What Licensee has obtained the benefit of any such price? We know of some who have paid 25 to 30 per cent more.

As for the guaranteed monopoly in the sale of small supplies, including lamps, in their territory, it is only a burlesque.

The fact is, as before stated, that the interests of the General Electric Company are diametrically opposed to carrying out their part of the Licensee contracts. They want the monopoly of the Licensees' purchases, but they will not and cannot give an equivalent. As an indication of the views taken in regard to the policy to be pursued toward the Licensees and infringers in Licensee territory, we quote an extract from a letter written by Mr. F. P. Fish as instructions to the company's agents. This was in the early months of the consolidation. After outlining terms of settlement to be proposed to infringers, always based on a contract for the latter to purchase all future supplies of the General Electric Company, Mr. Fish said:

> "It may be that some lamp user may say that he does not know whether the Light Company authorizes this sort of thing and would be satisfied with it. The agent should bluff him off from this position in every way in his power, telling him it is nonsense, and the guarantee of the General Electric Company is all he requires. As a last resort, however, the agent would be justified in saying that the assent of the Light Company to the contract could be secured."

It is worth remembering that neither the public nor the Licensees have been bluffed off from their position to any extent.

That the great majority of the Licensees fully appreciate the attitude of the parent company there can be no doubt. It was clearly proved a year ago in the displacement of the old officers, some of whom were salaried men of the parent company, recognizing no other obligation except to their employers, and some who were known to be closely connected with the President of the General Electric Company in various deals. They were replaced with men who would stand for the Licensees first, last and forever.

The patent situation offers no encouragement from the Licensee standpoint. The controlling patents are not sustained, save the lamp patent, and the failure to make any money out of the latter is apparent to everybody. There are five independent lamp companies in the field to-day all selling lamps in licensed territory or any other territory where there is a customer. An extension of the lamp patent for four years or for forty years, if that were possible, would not give the General Electric Company or the Licensees a lamp monopoly. Millions have been spent in the struggle for the unattainable. A lamp monopoly is impossible—just as surely so as the enslavement of the American people. And the chances are 100 to 1 that the United States Supreme Court will declare the Edison patent void after next November, thus ending the struggle.

The feeder and main patent has only a few weeks (less than two months) to run, and it has never been sustained. The compound winding patents and those on connecting machines in multiple are ridiculous. The three-wire patent is alone worth considering. It has not been sustained, but possibly will be if the General Electric Company escapes a receivership long enough to bring the suits to conclusion. A receiver will not fight patent suits. It will be remembered that this system, however, was not heard of on this side of the water until the news of Dr. Hopkinson's invention had been cabled to Mr. Edison by a fellow-worker then in England. Then the Edison patent was rushed in, and is presumably legal. But the three-wire system is not an essential feature of a modern central station. There are other equally good systems.

We are on the verge of developments in the art which would give a two wire system immense advantages over the present Edison 110 volt three-wire service. In fact these developments have passed the experimental stage. They are thoroughly worked out, and almost ready for announcement. We refer to a 250 volt incandescent system. Two hundred and fifty volt lamps are ready for the market from three or four different manufacturers.

It was found in the earlier years of the art that a lamp having about 220 ohms resistance was about as high as could be reached, so the 110 volt lamp of 220 ohms resistance, consuming half an ampere, became the standard 16 C. P. lamp and has remained so practically to the present day; Edison knew, and others knew quite as well, that if he could produce a stable filament of double the resistance, or 440 ohms, he would have a lamp with which the 110 volt lamp could not compete. We could then use 220 volts in transmission, supply four times the number of lamps from the same copper, or reach out in all directions over wider areas. No one was able to produce such a lamp, but the same result was accomplished practically by the three-wire system which has permitted us to transmit energy to the lamps at double the potential, viz., 220 volts, and there use it at 110 volts. This three-wire system of distribution gave the Edison stations a decided advantage over all competitors in direct current incandescent lighting. This advantage will vanish at once unless the Edison Licensees are in a position to take advantage of the improved system.

Consideration of the Licensee situation in this matter brings up the question of Edison tubing, which has been used in all the underground work of the companies. Will it be of any use when higher voltages are required, as they soon must be? The insulation is not of a high grade, nor has it ever been claimed to be but only that it was sufficient for the low potential heretofore used by the Edison Licensees. The expense of burying the circuits has been enormous. In Cincinnati, for instance, it has been stated that the Edison conduit system cost not less than $500,000. In New York, Brooklyn, Boston, Chicago and Philadelphia the figures are greater than in Cincinnati. The underground system has been in fact about one-third of the total outlay in large cities. Now if the insulation in these tubes is barely sufficient for the lower voltages used, all of these tubes must be absolutely abandoned upon the advent of the new voltages of over double the old. What advantages, therefore, can be offered the Licensees to continue as such on this score? If they are obliged to abandon their old conduits and build new ones, they would much better adopt a style of conduit that can be bought in the open market.

There has been up to recently little demand for such tubing outside of the Edison companies, and they have thus been compelled to buy of the parent company, as there is never a supply of such product until the demand has arrived. Once let it be known that there would be a market for it and it is a moral certainty that many manufacturers would produce something equally flexible and with an insulation many times higher. And as for patents, the "art of tubing" is free to the world.

There are, indeed, on the market to-day styles of conduit universally admitted to be superior to the Edison, into which wires may be drawn carrying their own insulation, whose resistance may be made high enough to meet any emergency, and in which other wires having increased insulation resistance may be substituted at any time should a new emergency arise.

The Edison Licensees have been misinformed in regard to this question of tubing. It has been built to carry only 220 volts, and in many cases does not do even this very satisfactorily. It will not stand any more and would be absolutely useless in the era of higher voltages.

It is not forgotten that it was a long time before the New York company, in the early days, could get tubing to carry even the 110 volt circuit, and the expense they were compelled to go to in changing from the two-wire to the three-wire system would have bankrupted an ordinary concern.

The fact is, the Edison system of tubing is considered out of date by every one except its present users, who have as a rule been afraid to look the situation squarely in the face, or have been wrongly convinced by the parent company which has made handsome profits out of its sale. The entire system is a fallacy, wrong in theory, expensive, and only a makeshift in the progress of the art.

We have shown, we think, just why there are no reasons, from the Licensee's point of view, for a continuance of the Licensee relations. There are reasons, almost without number, why the Licensees should put an end to these relations and to their stock obligations; they must now either stand on their own bottom or forfeit their supremacy in the incandescent lighting field.

With the advent of foreign manufacturers in the American market who are experts in dynamo building, with the Edison patents no longer a bugbear, with a half dozen manufacturers of first-class lamps ready to sell to anyone who can pay for them, and with the perfection of the alternating current system, the Edison Licensees are no longer secure against strong competition even in the largest cities. Even the New York Company, which has been supposed to be the most strongly intrenched, will have from this fall forward a rapidly increasing competition. We refer here to the United Electric Light and Power Company, now in strong financial condition and ready to prosecute its business with energy.

What the body of Licensees must consider at once is this: Are they not weakening themselves every month by the continuance of Licensee relations, from their inability to take advantage of the progress in the art and in incandescent central station work?

Perhaps the strongest menace to the continued supremacy of the Edison Licensees in their respective territories is from alternating current stations—stations which could make enough money in the outlying districts, not possible to be reached with the Edison circuits, to warrant their establishment. They would not be forced, like the Edison stations, to locate in the heart of the city, but could build their plants as they are doing, where real estate is cheap, where water costs nothing, and where they would have many other advantages which suggest themselves at once.

The Edison station men themselves are gradually being converted to a belief in the alternating system. They will certainly be compelled to adopt it, either as a substitute for or as an adjunct to their present system, or see the best part of their business go to others. Some of them, as in Williamsport, Lancaster and York, Penn., have already come to full realization of this fact, *after* the new rivals have become thoroughly established and demonstrated their ability to make money. The rank and file of the Licensees should take this matter up before competition is established.

And although the General Electric Company has an alternating system to sell, it is one which is not taken seriously by any one except its promoters. In this branch of the business the General Company has never been in the race, and probably never will be. Here again the Licensees must look elsewhere for the latest developments in the art.

They must continue to increase their plants, and consequently their capitalization. How much longer can they give up 25 to 33⅓ per cent. of their increases without weakening themselves beyond the hope of success? Already they are badly handicapped as to capitalization in comparison with new companies which could be organized to-day. Rival companies could be started in the territory of even the most conservatively financed Edison Licensees, performing equal service with an investment 50 per cent. smaller, and in some cases 60 per cent. Can they afford longer to go on piling up this unwarranted capitalization—in payment for what?—simply the right to pay the highest price for apparatus which is almost out of date.

For the latest developments in the art they have got to look beyond the General Electric Company, and very soon, else they will find themselves in all the best territory confronted by rival companies, with more improved systems, more economical in operation, and with a capitalization one-half that of the Licensees. In such a competition it is not difficult to see which company would have the advantage.

The Edison Licensees can maintain for the next generation continued supremacy in incandescent lighting in their respective territories; they can only do it by going into the open markets of the world for their supplies, and by taking instant advantage of improved systems, perfected by the leading engineers of the world. No engineer fit to rank in this class is at present, nor has been for many months, working in the service of the General Company. The Licensees can only maintain their position by seeing to it that the proportion of water in their capitalization does not increase.

This continued turning over of a percentage in increases of capital stock, under late conditions, is not according to the spirit of the original contracts. Those contracts presupposed the continued progress of the parent Edison Company, producing each year valuable inventions and improvements. It was these expected inventions and improvements for which the Licensees agreed to make future surrenders of stock. The old patents were paid for long ago. What new rights of value have the parent company turned over to the Licensees in the last two years? What are they likely to turn over in the next two years?

Licensees are losing ground every day that the Licensee arrangements are continued, and it will not be many years until the percentage of dividend payers will be nearer 5 than 95 (which it is now) unless these arrangements are brought to an end.

This matter surpasses in interest any or all papers which will be read at the Boston meeting.

Separation means a strengthened position and continued success. Continuance of present relations means ultimate bankruptcy for a large percentage of the Edison Licensee Companies.

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The Sad Degeneracy of an Electrical Contemporary. Up to the present time the electrical press as a unit has maintained a very high standard in its attitude towards articles of manufacture in the electrical line, and none has been so poor as to accept advertisement of, or to describe, except for the purpose of ridicule or warning, any electrical device which partook of the nature of a "fake." Thus, while there might have been money in it for the electrical press to have given reading notices of the various electrical belts, and to have accepted the advertisements of their manufacturers, it has without exception refused both the advertisements and reading notices of these concerns. Some of the papers have been brave enough to condemn these so-called therapeutic appliances in a sort of half-hearted way, but no paper in this country except ELECTRICITY has so unqualifiedly condemned them as do our English contemporaries. To illustrate the point in question, one of our contemporaries upon learning that an English judge had sentenced an electric belt manufacturer to five years' imprisonment, exclaimed editorially: "*What a blessing it would be if we had such courts and laws in this country!*" forgetting that its own mission was to arouse public opinion to such a pitch as to make such decisions in this country possible, so far as its feeble efforts could contribute to this end. We expressed our contempt for the position in which said contemporary placed itself by this vapid exclamation by one which was short and to the point, viz., "Oh, ——!!" leaving our readers to fill in the blank with any expression that seemed to them appropriate.

But this was not what we started out to say. Although heretofore the electrical press has uniformly excluded from its columns all literature savoring of endorsement of fake electro-therapeutical appliances, the same is no longer true. Be it said to its everlasting shame, the *Electrical Engineer* in its last issue (p. 120) prints a description of an *electric hairbrush*, which is so worded as to appear to carry with it editorial endorsement. The title to the article is "A Genuine Electric Hair Brush," and the article goes on to show why it is a *genuine* electric hairbrush, viz., because it *does* give an electric current. If it justifies itself in publishing this article on that ground, it would have equal justification in advertising or writing up the electric belts, for the reason that most, if not all, of the electric belts also give current. If the electric belt is justly entitled to be termed a "fake," and unworthy of being seriously discussed or of being advertised in the columns of the electrical papers, this electrical hairbrush must be placed in exactly the same category by whatever method we gauge it. It is not to be expected that the daily press should discriminate between the genuine and the false, but the standard of morality of the electrical press has heretofore compelled it to frown down electrical imposture wherever it raised its head. We sincerely regret that the *Electrical Engineer*, once so dignified and so influential, should have fallen so low as to endorse such things as the electric belt and the electric hairbrush. How have the mighty fallen!

Siemens & Halske.

We are advised from Chicago that the Siemens & Halske Electric Company of America have purchased one of the best equipped manufacturing establishments in the country and will soon be in the field, better prepared than before for turning out the large sizes of machines which they have made their specialty and with such marked success.

THEY'RE A-BREAKIN' OF THE TRUST.

I have made for you a song,
And I'm sure it's right, not wrong,
For events are daily telling us it's true,
I have tried for to explain
That your pleasure's turned to pain—
So, Charlie, here's my best respects to you!
For there'll surely come a day
When you will get your pay
For the trouble which your avarice did brew;
That day is coming round,
We all can hear the sound,
And its coming no impartial man will rue.

(Air—They're Hangin' Danny Deever in the Mornin'.)

"What are the people shoutin' for?" says Coffin, sore afraid.
"To turn you out, to turn you out," your Nemesis has said.
"What makes me look so white, so white?" says Coffin, sore afraid.
"You're dreadin' what is comin' next," your Nemesis has said.
For they're breakin' of the Trust—you can hear the Dead March play;
The fates decree an early death, they're breakin' it to-day;
They've taken of the profits from your business all away,
An' they're breakin' of the Trust in the mornin'.

"What makes the d'rectors cuss so hard?" says Coffin, sore afraid.
"You humbugged them, you humbugged them," your Nemesis has said.
"What makes the widows scorn me so?" says Coffin, sore afraid.
"You swindled them, you swindled them," your Nemesis has said.
They're a-breakin' of the Trust, they're a-kickin' it around,
And they soon will have it sepulchred beneath the oozy ground;
For there's nothin' left to save it, nothin' in it that is sound—
O, they're breakin' of the Trust in the mornin'.

"What makes the Licensees so hot?" says Coffin, sore afraid.
"They want their rights, they want their rights," your Nemesis has said.
"Why does the public hate us so?" says Coffin, sore afraid.
"They won't be robbed, they won't be robbed," your Nemesis has said.
The Licensees grow hotter, they are after you, my son;
They want their rights, they'll have 'em, too, or else they'll have some fun.
They control the situation, they have got you on the run,
An' they're breakin' of the Trust in the mornin'.

"Why do the Independents shout?" says Coffin, sore afraid.
"They're lickin' you, they're lickin' you," your Nemesis has said.
"Why don't infringers close their shops?" says Coffin, sore afraid.
"The patent's out, the patent's out," your Nemesis has said.
They're a-breakin' of the Trust, and their tents they will not fold;
They have hit you in the midriff, as ELECTRICITY foretold;
They are filling all the orders, while your goods remain unsold—
Thus they're breakin' of the Trust in the mornin'.

"What makes my Boston friends so cold?" says Coffin, sore afraid.
"They trusted you, they trusted you," your Nemesis has said.
"What ails my million-dollar smile?" says Coffin, sore afraid,
"'Twas overworked, 'twas overworked," your Nemesis has said.
You played them all for suckers, you pulled the Yankee leg,
And now they're more'n likely to take you down a peg;
Your crookedness has killed the goose that laid the golden egg,
An' they're breakin' of the Trust in the mornin'.

"Who'll pity me, who'll pity me?" says Coffin, sore afraid.
"The men you always treated square," your Nemesis has said.
"But there are none, but there are none," says Coffin, sore afraid.
"'Tis sad but true, 'tis sad but true," your Nemesis has said.
They're a-breakin' of the Trust, an' the job is almost done,
They're a hittin' it and crackin' it as when they first begun;
It's like will never more be seen, an' knowin' this 'tis fun
To be breakin' of the Trust in the mornin'.

THE DEVELOPMENT OF THE ELECTRIC TELEGRAPH.—VII.

BY STEPHEN VAIL.

On April 22d, 1844, he wrote: " . . . . We now have the wires up sixteen miles, and yesterday afternoon I tested them by telegraphing from White Oak Bottom to Washington. *We talk back and forth* almost every day, and find it to succeed very well, and I see no reason why it should not go through the whole distance. It is progressing very fast, and we hope to have it through by the middle of May, when you may expect a great noise in this part of the world. As it is, I see the papers are full of it, but they do not keep pace with our operations. It excites considerable interest and astonishment wherever it is known or seen, and we have lots of fun sometimes with those who are curious to know everything. At this end of the line yesterday the shocks were very severe, so much so that I could hardly manage the wires. Just imagine posts, 200 feet apart, along the railroad, with two wires stretched between them, and you have the telegraph. The lead pipe we are selling for old lead, so that much goes back into the appropriation." [This refers to the leaden pipes in which were placed the wires and both buried in the ground, as was done at the outset of the line's construction.] "We have enough, and more than enough, to take us through. What will be the result to our pockets after what is completed, and before Congress, I know not. Perhaps they will make another appropriation, or we may settle with them for the whole of it. Perhaps not. I do not think much about it at present. I want to see it in operation first. . ."

On April 28, 1844, he wrote: " . . . It is as much as I can do to keep Prof. Morse from being sick, and he don't seem to know sometimes how to operate his own instrument. I have spent the week as usual, and to-morrow go to the Junction, twenty-two miles from here, to prepare to announce the Whig candidate selected by the Baltimore Convention. Yesterday I was at Bladensburg, and the day being wet and cold, and I without my coat and umbrella, I wrote, by telegraph, to Prof. Morse, to send them to me by the four o'clock train, *which he did. So you see it works well.* . . ."

On May 1, 1844, Prof. Morse wrote to Mr. Vail at Annapolis Junction: "Get from passengers in the cars all the news you can and transmit. A good way of exciting wonder will be to tell the passengers to give you some short sentence to send me, and let them note the time and call at the Capitol to verify the time I received it. Before transmitting, notify me (48). Your message to-day that the passengers in the cars gave three cheers for Henry Clay excited the highest wonder in the passenger who gave it to you to send when he found it verified at the Capitol."

On May 2d, 1844, Mr. Vail wrote to Mrs. Vail: " . . . I yesterday announced the nomination of Henry Clay and Frelinghuysen, at Washington, one hour and a quarter before the cars arrived there, distance 22 miles. Prof. Morse is so unstable and full of notions. He changes oftener than the wind and seems to be exceedingly childish sometimes. Now he is elated up to the skies, and then he is down in the mud all over under. The telegraph produces a great deal of excitement and we are thronged with visitors. When we get to Baltimore it will be still more astonishing. Persons at the Capitol ask Prof. Morse to ask me to write their names, that they may say that they were written in Washington by a person at the Junction. I was obliged to write Mr. Frelinghuysen's name a dozen times last night for as many persons who wanted the intelligence. I hope the thing will come to something by and by! . . ."

On May 11, 1844, Prof. Morse wrote to Mr. Vail: "Everything worked well yesterday. I shall have a great crowd to-day, and wish all things to go off well. Many M. C.'s will be present, perhaps Mr. Clay; give me news by the cars. When the cars come along, try and get a newspaper from Philadelphia or New York, and give items of intelligence. The arrival of the cars at the Junction begins to excite here the greatest interest, and both morning and evening I have my room thronged."

The following note referring to the receipt by him on the 24th of May, 1844, of the so-called "historic message," was found in Mr. Vail's diary:

"Baltimore, May 24, 1844.

"What hath God wrought?—M. Yes.—V.

"The city of Baltimore.—V. Yes.—M.

"Stop a few minutes.—M. Yes.—V."

After the opening of the line between Washington and Baltimore on May 24, 1844, up to April 1, 1845, the telegraph was operated as an exhibition without charge, and it was hoped during that time by the inventors that the Government would purchase and assume control, but no movement was made by Congress to that end. A few months after the opening in 1844, the owners of the invention received an offer of $200,000 for it, and the acceptance of this offer was made conditional on the consent of Alfred Vail, who when he received notice of this fact in August, 1844, wrote to Henry Clay, telling him of the offer and asking his advice. After stating that he believed that the General Government should have the refusal of the telegraph, he says that the whole question of the sale had been left with him, and he is at a loss to know what to do. He then goes on as follows: "Having been personally and daily engaged in experimenting, and my mind, with every day's experience, expanding with the progress and the development of the telegraph, I have taken [illegible] broader view of the subject and its results than mere dollars and cents, and the more I reflect upon it the more I am led to believe that the electro-magnetic telegraph is destined to have and to exert a greater amount of moral influence upon the community, if under proper guidance, than any discovery in this or any part of the world. If, on the other hand, it should be controlled by vicious and designing men, possessed, so to speak, of the attribute, or rather of the faculty, of ubiquity, what amount of evil may they not inflict upon that same community in a political, moral, and in fact in every point of view that can be conceived of! The questions upon which I ask advice are: Whether or not the Government should have the refusal, and the probability of the Government's taking it? I do not pretend to more patriotism than my neighbors, and I believe I look to my own interests closely, as every man should do, and I profess to have an innate and abiding sense of duty and care for the prosperity of my country and the perpetuity of the liberties we enjoy, which every man should possess whose privilege it is to live under such a Government as ours. The questions are propounded and the opinion solicited for myself alone, for my own satisfaction, before I act in the premises, subject to any suggestions you may be pleased to communicate. Should I have transcended the bounds of propriety in making the appeal, I trust you will pardon the humble individual whose observations of passing events has led him to esteem you as a public benefactor, and ascribe it to the profound respect of

"Your obedient and very humble servant,

"ALFRED VAIL."

To this Henry Clay replied in an autograph letter as follows:

"Ashland, 10 Sept., 1844.

"DEAR SIR: Absence from home and the pressure of a most burdensome correspondence have delayed my acknowledgment of the receipt of your favor of the 15th ultimo. I should be most happy to give you a satisfactory response to your inquiries respecting the electro-magnetic telegraph, but I fear I can say nothing that will in the least benefit you. Assuming the success of your experiments, it is quite manifest that it is destined to exert great influence on the business affairs of society. In the hands of private individuals they will be able to monopolize intelligence and to perform the greatest operations in commerce and other departments of business. I think such an engine ought to be exclusively under the control of the Government, but that object cannot be accomplished without an appropriation of Congress to purchase the right of the invention. With respect to the practicability of procuring such an appropriation from a body governed by such various views, both of constitutional power and expediency, you are quite as competent to judge as I am. As the session of that body is now nigh at hand, I submit to you whether it would not be advisable to offer your right to it before you dispose of it to a private company or to individuals. If I understand the progress of your experiment, it has been attended with further and satisfactory demonstrations since the adjournment of Congress. I am, respectfully, your friend and obedient servant,

"H. CLAY.

"To Alfred Vail, Esq."

(*To be continued.*)

The Effect of Extreme Temperatures Upon Matter.

BY NELSON W. PERRY, E. M.

The ancients believed the world to be flat, as it appeared to be from their limited range of vision, and that the sun and moon and stars revolved about the stationary locus of their abode. The ideas of the universe resulting from such a conception, while sufficient for their philosophy of existing things, seem to us of this age crude in the extreme. But we are still prone to philosophize about things that are seen, unconscious of that larger universe which lies beyond our usual experience. It has been the province of science to investigate these unfathomed depths and to extend by its discoveries our vision of things. That there is an unseen universe about us not less interesting or less tangible when we once know how to grasp it is becoming more and more apparent every day as new paths are opened to us for investigation. Usually these paths are first suspected on merely theoretical grounds, and if tenable from this standpoint are explored later in the more practicable way of experiment. Take, for instance, the world as we know it. What changes might be wrought by a slight change of temperature! The ranges of temperature with which we are familiar are exceedingly small when we think of the possibilities in this line. Within this limited range we are now pretty familiar with the properties of matter, but may they not be entirely changed at a thousand degrees below zero or at a thousand degrees above the temperature of melting platinum? This is one of the interesting questions with which science has of late years been concerning itself and upon which much has already been discovered.

We are all familiar with the fact that nearly all substances are expanded by heat and contracted by cold, but it remained for nice scientific methods to determine just what relation this expansion and contraction bore to the increase or decrease of temperature. Temperature is measured by certain arbitrary standards known as degrees, which have different values on different thermometers. Thus in the Fahrenheit thermometer the greatest degree of cold which it was at one time thought possible to attain, viz., that resulting from a mixture of snow and salt, was marked zero and the boiling point of water was marked 212. The distance between this zero and the freezing point of water was found to correspond to 32 of the 212 divisions into which the larger range was divided, and is so marked. The French took the freezing point of water and its boiling point as their data for measurement, and divided this distance arbitrarily into 100 equal parts, calling the freezing point zero and the boiling point 100. From the number of divisions this scale is called the centigrade scale, and as a matter of convenience it is the one universally employed in scientific investigations and the one that will be used here.

In studying the change of volume with temperature, of gases, it was found that a volume of gas at 0° centigrade increased or decreased just $\frac{1}{273}$ for every degree it was heated above or cooled below that temperature. This meant that if a given volume of gas at 0° C. were heated to 273° C. it would occupy just double the space, and experiment proved this to be true. But it implied more than this. It implied that if it were cooled to 273° below zero it would have no volume at all. It would disappear, not, as the saying is, into thin air, but into absolute nothing, which is as near the beginning of things as our conceptions are able to reach. Scientific men, therefore, constructed another thermometer scale in which the zero, which in Fahrenheit's scale was 32 of his degrees below the freezing point of water, was 273° of the centigrade scale below the freezing point, and called this new zero the absolute zero. The freezing point on this absolute scale would therefore be 273° and the boiling point 373°.

Of course we cannot conceive that at 273° C., or any other temperature, a gas will entirely disappear, and it is not for a moment supposed that it will. It is known that many substances which are gaseous at ordinary temperatures condense to liquids at lower temperatures, and that long before they are cooled sufficiently to condense into liquids they cease to follow rigidly this ratio of contraction and as liquids follow an entirely different law. But within the range of temperatures attainable, until recently, there were a number of gases which still followed this law of contraction throughout the whole experimental range, and to these were given the title of permanent gases. Science has not yet succeeded in producing a temperature of absolute zero, but has approached pretty closely to it, and with each material advance has succeeded in lessening the number of so-called permanent gases until at present there is but one that holds out against its assaults. This is hydrogen gas, and it is not only the most refractory but it is the lightest of all gases. Carbonic acid, which was for a long time counted among the permanent gases, was one of the first to succumb to systematic attack, and as a liquid has been an article of commercial manufacture for several years. Since then, one by one they have all given way, as before stated, until only hydrogen remains on the list.

Prof. Dewar, of England, has penetrated further than anyone else into those depths of cold, and has succeeded in obtaining a temperature within 73 degrees of the absolute zero. In order to realize what this means we must translate it into terms more familiar. It means 200° according to the centigrade scale or over 328° below zero of the Fahrenheit scale.

At this temperature oxygen and nitrogen and even air are condensed to liquids, and these well-known elements are presented for study under entirely different conditions from those under which they have been heretofore known; but still hydrogen conforms to the law of permanent gases, and even at this low temperature continues to contract in nearly the same way that it does at higher temperatures. Whether it will condense or not at the absolute zero is, of course, as yet unknown, but it cannot follow this law much further. As before stated, it is inconceivable that it should disappear entirely—suffer complete annihilation—but each succeeding step towards zero will be followed with interest for other reasons than the one we have followed.

It has been observed that the chemical activity of all substances decreases with the temperature, and the ratio of this decrease also points to a temperature at which it must entirely cease. In electrical science it has long been known that the resistance which metallic conductors offer to the passage of the electric current increased and decreased in a certain ratio with the temperature —decreasing as the temperature decreased. This ratio of decrease of resistance with decrease of temperature also points to a temperature at which all resistance must cease, and strangely enough both of these zero points correspond with the absolute zero above referred to. It was with great interest, therefore, that the behavior of chemicals and of electrical conductors at Dewar's lowest temperature have been studied to see if they conformed to the laws just enunciated, and it was noted with satisfaction that they did.

Prof. Dewar describes liquid oxygen as a "pale liquid, strangely lustrous," and finds it strongly attracted by the magnet, just as iron is but to a less degree. In this condition it refuses to unite with phosphorus, with which as a gas it has the strongest affinity. It was by the evaporation of liquid oxygen that he was enabled to liquefy not only nitrogen but also atmospheric air, and to go even further, to solidify them both. Solidified air is described as a structureless glass, while solidified nitrogen is a white crystalline substance. Solidified oxygen in its isolated form has not been produced, and it is not yet known whether in the solidified air it existed as a solid or whether it was held suspended in liquid form as water in jelly. Other observations at these low temperatures show that there is no chemical action between nitric or sulphuric acid and potash, or between oxygen and potassium, so that the theory that all chemical affinity as well as electrical resistance of metals at the absolute zero disappears receives strong experimental confirmation at the temperatures already attained.

It would seem, therefore, that all molecular motion must at that temperature cease, and absolute death even of inert matter must there be attained. Some one has written of "the music of the spheres," referring to the rythmic motion of the planetary bodies, and has said, in the end this music will be hushed. If we could conceive of a sentient being so infinitesimally small that compared to him the atoms of matter were relatively as large as the planets are to us, he, too, might in poetic mood refer to molecular motions such as light, heat and electricity as engaged in a harmonic symphony which, like that grosser symphony of the planetary spheres, will be hushed into the absolute stillness of death at the absolute zero, which is attained, it is believed, in interplanetary space.

On the other hand some investigations have been made as to the condition of matter at temperatures at the other end of the scale. There is nothing, however, in its behavior to indicate an exterior limit of temperature short of infinity, so that experiment in this has been less fruitful of results than have those in the other direction. It was believed, however, that as all things could be liquefied or solidified were the temperature reduced sufficiently low, so all solids could be liquefied or vaporized if subjected to suitable temperatures in the opposite direction. While hydrogen still remains refractory at one end of the scale, carbon was the last to succumb at the other end. With the electric arc all things have at last been fused and volatilized even to refractory carbon, and the electric arc, such as we see nightly on the streets in the arc lamp, produces the highest temperature attainable until recently by science.

The electrical world is, however, just now agitated over a discussion of a new method of obtaining heat by which even higher temperatures than those of the electric arc are supposed to be attainable. Strange as it may seem, these temperatures are obtained only under water, or are at least best obtained in that way. The method referred to has been patented by two Belgian scientists named Lagrange and Soho, though undoubtedly discovered before them by others, and may be briefly described as follows: If a current of electricity be passed from a large plate of some conducting substance, such as lead, through a bath of acidulated water to a small pencil of carbon or other conductor immersed in the liquid, the pencil will at once be surrounded with an intensely luminous envelope of incandescent hydrogen gas. The heat of this is soon transferred by conduction to the pencil, and if the latter be of iron or of other fusible material it will in a few moments be melted entirely away. It has been claimed by Soho and Lagrange that carbon itself is thus melted and drops down into the bottom of the vessel resolidified into the form of graphite. It is also claimed by the same authorities that temperatures as high as 8,000 degs. centigrade are thus attainable, which, translated into Fahrenheit units, means nearly 14,500 degrees.

But it is found that whereas, generally speaking, the chemical activities of the elements increase with the temperature, in most, if not all cases, a maximum is reached beyond which any increase in temperature lessens those activities and chemical compounds are split asunder. Thus it may be stated as a general truth that all organic compounds are destroyed at or below a red heat. Many of the inorganic chemical compounds have thus far resisted even the highest available temperatures, but the tendency is distinctly in the direction outlined, and there is no question in the minds of physicists that with sufficiently high temperatures all chemical compounds would be split up into their elementary parts. Not only this, but speculative philosophy goes further. There are numerous reasons why the so-called elementary bodies are suspected of being themselves composed of aggregations of still more elementary substances, into which, though they have thus far defied all attempts, they may, if the conditions are right, be separated. One of the reasons for believing in the composite condition of the elementary substances is the striking relation discovered by the Russian chemist Mendelejeff between the atomic weights of the elements and their properties. He finds that the elements may be arranged in a number of series, the succeeding members of each series differing from the preceding by equal increments in atomic weights, and the different series differing from each other atomically by the size of this increment. We have an exact analogy to this in organic chemistry, where, as in the paraffin group or in the alcohols, the general character of the series is determined by the increment of molecules by which each series is built up, and the specific character of each member of a series is determined by the specific increment by which it is differentiated from its neighbors in the same series.

So definite does this relation between the atomic weights of the elements and their properties appear to be that Mendelejeff was able to predict and give a description of some new elements which their subsequent actual discovery has substantiated as remarkably correct.

This, taken in connection with the fact that in the spectroscopic examination of the heavenly bodies their composition seems to be simpler as their temperature is higher, seems to strengthen the hypothesis that at high temperatures even the elements are resolved. In the study of the different parts of the sun's disk there is shown to be a regular progressive change towards complexity from the hotter to the cooler areas of the photosphere. It is singular, perhaps, that in the hottest portions little but hydrogen is observed, whereas in the cooler portions nearly all of the known elements of the earth are shown to exist. It would therefore seem probable that hydrogen is the basis of all matter—that it is in fact both the alpha and omega—that it alone of all forms of matter defies change, and was in the beginning and will be in the end.

Test of a Closed-Coil Arc Dynamo.

BY PROF. R. B. OWENS AND C. A. SKINNER.[*]

That so much has been said and written concerning the design of constant potential machinery, effects of armature reactions, control of sparking, etc., and so little concerning the machinery used for arc lighting, seems rather remarkable considering the fact that by far the larger part of our outside lighting as well as much inside lighting is done by means of arc lamps in series, and I hope a discussion will follow in which more light will be thrown on the principles of design of arc machinery, for at present there seems to be much empiricism in the matter.

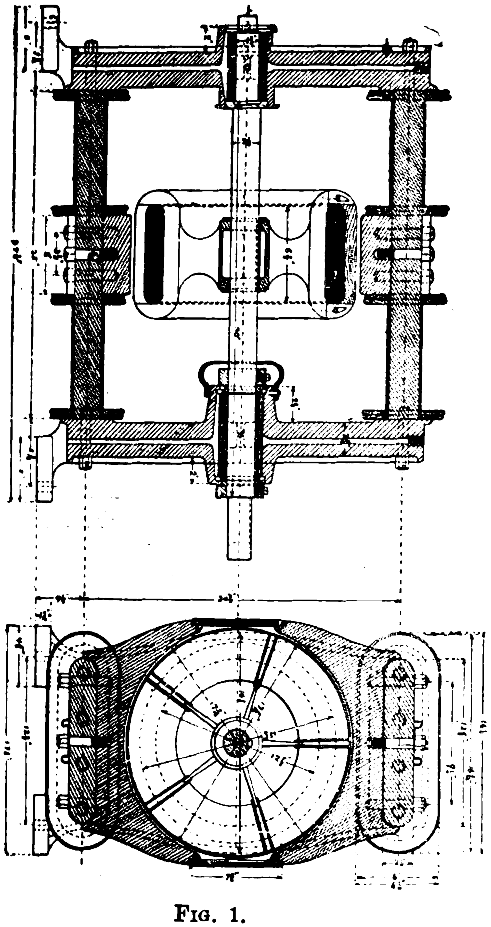

FIG. 1.

The immediate object of the present paper is to show something of the nature of the armature reactions which occur in arc light machines of the closed-coil type, maintaining constant current by automatically shifting the brushes to correspond with changes in load in the external circuit, and to point out certain alterations in design which, it is believed, may be adopted with advantage. Incidentally other points will be noted. Of course there are other well-known methods of maintaining the current constant: notably by shunting the field magnets as in the Brush machine, or a combination of this with shifting the brushes as in the new Excelsior machine, or by varying the length of time per revolution during which the armature coils are in series and shunt to each other or short-circuited as in the T.-H. machine, but these will not be considered at present. Nor is it intended here to discuss the relative advantages of the several types, but only to give some results obtained in a test of a closed-coil machine regulating as above mentioned. Such machines are now taking a prominent part in the arc lighting industry, and their prominence merits for them more close study. Alternating current dynamos, as the Westinghouse arc light machines, have been devised which keep the square root of the mean square of the current remarkably constant through extremely wide variations in load and without any external regulating mechanism whatever. They possess many advantages, but are not now widely used, for arc lamps seem as yet to work more satisfactorily on continuous current circuits. We believe it is also possible to build continuous current arc machines which by armature reactions alone can keep the current very nearly constant throughout a considerable range, but it would seem that their cost would be more and their efficiency less than in some of the types using an external regulating mechanism, although we have no exact comparative data.

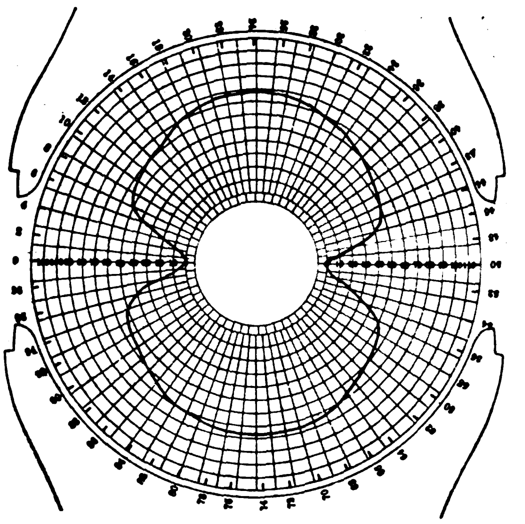

FIG. 2.

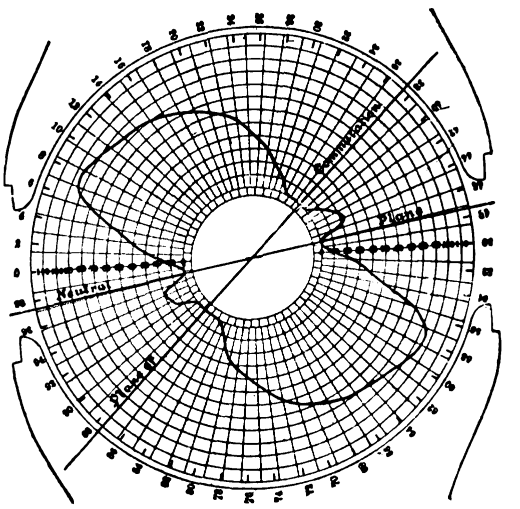

FIG. 3.

The machine on which the following experiments were made is a No. 6 25-light 2,000 C. P. Wood arc dynamo, a scale drawing of which is shown in Fig. 1.

From the drawing all dimensions of magnet limbs, yoke, pole-pieces, armature, etc., are at once seen, its designer, Mr. James J. Wood, most courteously consenting to my giving the name of the machine tested and its full data.

The winding data and other details as furnished by the maker are as follows:

The field magnet winding is composed of four coils of No. 10 B. and S. gauge copper wire, single cotton covered. The outside diameter when insulated is 0.114 in. Each coil contains 100 lbs. of wire in 15 layers of 74 turns each.

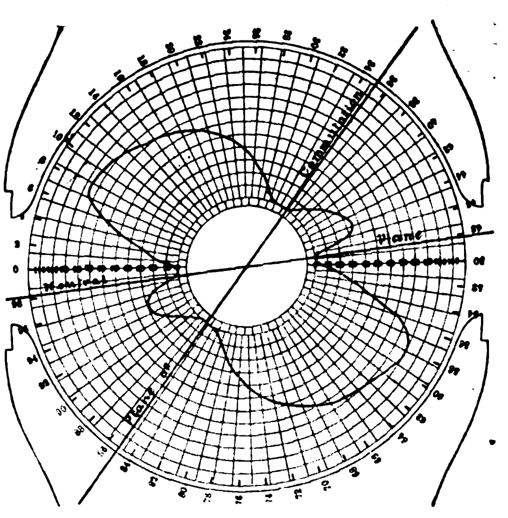

FIG. 4.

The insulation of the magnet cores is $\frac{1}{8}$ in. thick and composed of one layer of enameled cloth, the enameled surface facing the iron, the remainder being composed of pressboard 0.025 in. thick. The magnet heads are wooden washers $\frac{5}{16}$ in. thick, carefully dried and shellacked.

The armature core is composed of No. 10 B. and S. gauge annealed charcoal iron wire. This is wound on a former which is removable, and is composed of 15 layers $6\frac{3}{4}$ in. wide. These wires are held together by interposed strips of linen tape. The core is then insulated with a layer of asbestos paper, three thicknesses of pressboard 0.15 in. thick, one layer of asbestos paper again, and then over this one more layer of pressboard 0.15 in. thick, making a smooth surface for the copper wires to be wound on. The insulations near the spider arms are built up of the same material and in the same manner as the armature core until they attain a thickness of $\frac{1}{4}$ in. The armature is wound with 100 sections of No. 14 B. and S. gauge double covered cotton wire. Each section is composed of 93 feet, or 57 turns per section, making a total of 115 pounds of wire.

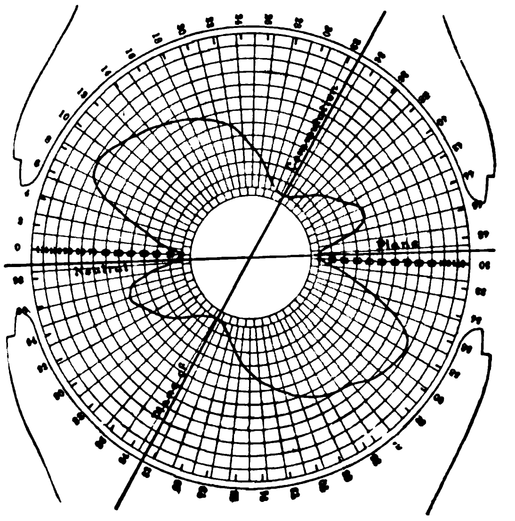

FIG. 5.

The regulator magnet is wound with No. 11 single cotton covered B. and S. gauge wire, in the manner shown on the dynamo, the insulation of the cores being $\frac{5}{32}$ in. thick and that of the magnet heads $\frac{3}{16}$ in. Speed of dynamo, 1,000 revolutions per minute.

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[*] A paper presented at the Eleventh General Meeting of the American Institute of Electrical Engineers, Philadelphia, May 16, 1894.

CONDITIONS OF TEST.

The dynamo was securely bolted to a firm foundation of masonry, and driven through a 7 in. belt by a small 8 in.x10 in. high-speed automatic Atlas engine making 250 revolutions a minute. Steam was supplied at as nearly constant pressure as possible. The automatic regulator of the dynamo was removed, together with one pair of opposite collecting brushes, and the remaining pair reduced one-half in width parallel to the commutator bars, to allow of easier manipulation of the exploring brushes, their angular width being, of course, adjusted for each load to prevent sparking.

It was at first attempted to use a number of arc lamps as load for the dynamo, but though carefully adjusted and using cored carbons the variations of potential and current due to their feeding was greater than could be permitted, so the lamps were discarded for two water rheostats, 4 feet x 1 foot x 1 foot, with carbon electrodes. These latter on the whole were found to work quite satisfactorily, their resistance hot was considerably less than when cold, but it changed so gradually that no trouble was experienced in correcting for it by adjusting the electrodes.

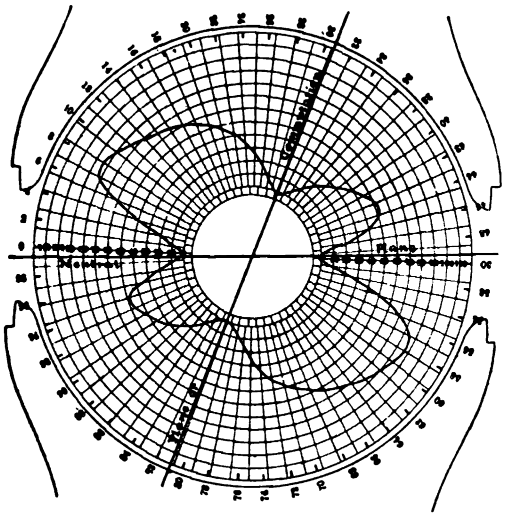

FIG. 6.

The distribution of the induction entering the armature at different loads was obtained by taking the E. M. F. at various points on the commutator between two small pilot brushes moved round and in contact with it.

The two-brush method, though somewhat more difficult to work than the single brush method, has the advantage over the latter of giving the quantities sought directly, instead of as a difference between quantities which are large as compared with those desired. In some cases the integral readings of the brush method have been plotted, but curves so obtained do not indicate so clearly what is mainly sought, namely, the distribution of lines of force entering the armature. True, one curve can be approximately obtained from the other if electrostatic instruments are used, but not with electro-magnetic instruments, for they will give only a mean E. M. F., depending on the relative width of a commutator bar and insulation and distance apart of the pilot brushes. The results obtained, however, with a voltmeter of the Weston type are proportional and for the present purpose are equally valuable.

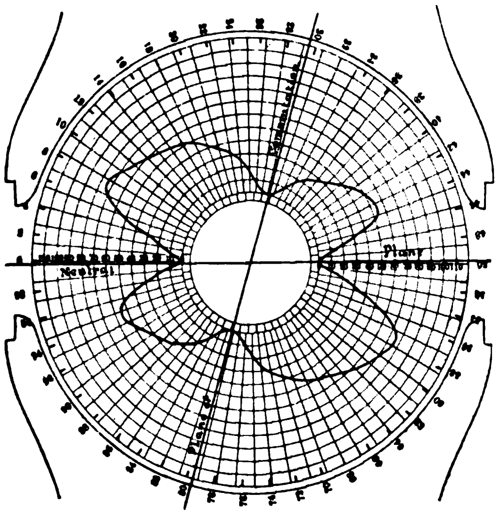

FIG. 7.

The exploring brushes as finally used were pieces of steel watch springs firmly held in small fiber holders. These, in turn, were rigidly secured by brass studs to a graduated sliding ring, moving within another stationary ring, attached to and insulated from the dynamo frame and carefully centered with the commutator.

Two brushes were used in each holder to better insure good contact. Copper, brass and phosphor-bronze exploring brushes were tried at first, but found not as satisfactory as steel. It was also found very necessary at all times to keep the brushes and commutator as clean as possible.

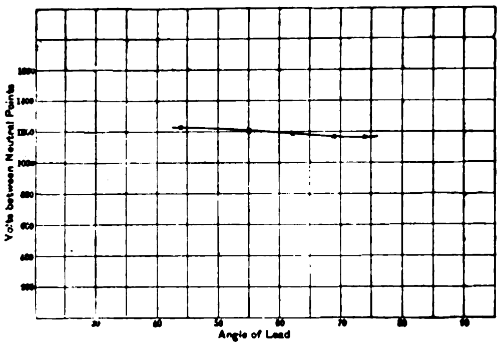

Fig. 8.

The sliding ring was marked off into 100 divisions, the number of commutator segments, and the exploring brushes made to cover just two commutator bars or one-fiftieth of the circumference, but the ring might have been divided into degrees if desired. The curves shown in Figs. 2, 3, 4, 5, 6 and 7 are plotted so that the results may be read either in degrees or in divisions of the graduated ring.

The inner circle, representing the commutator of 100 segments and the 100 divisions of the ring, are marked on the outer circle.

The radial lines are 5 degrees apart, and the radial distance between concentric circles represents 10 volts. If the results had been plotted on a developed diagram, then the areas of the curves would have represented total or integral electromotive forces, but the circular diagram has the advantage of appealing more quickly to the eye, and though the total E. M. F. is not exactly represented by the area it is proportional to the number of the small approximate rectangles enclosed. In obtaining efficiency measurements the power delivered to the dynamo was obtained by indicating the engine. The cards were taken with a Tabor indicator and worked up with a Coffin averaging instrument; the speed was obtained by a speed counter and stop watch; the electrical instruments used were a Weston 0.15 amperemeter for current measurements, a Weston 0.15 and 0.150 voltmeter for potentials between pilot brushes and a 0.150 and 0.1500 Weston voltmeter for total electromotive forces. All instruments were previously calibrated.

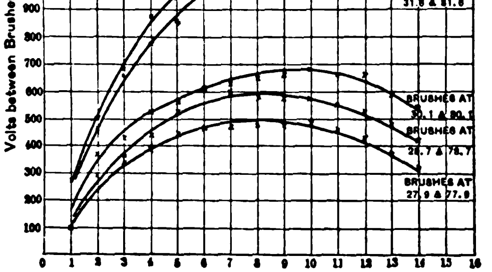

FIG. 9.

RESULTS OBTAINED.

Fifteen sets of readings, fifty readings per set, were taken around the commutator with currents in armature and field of 8, 10 and 12 amperes at positions of the collecting brushes approximately corresponding to loads of 5, 10, 15, 20 and 25 lights. Three sets of readings were also taken with currents in the field of 8, 10 and 12 amperes and no current in the armature. The results obtained are given in tables (not printed) and for a current of 10 amperes are plotted in corresponding plates.

The reactions of the armature are so clearly shown by the curves that comment hardly seems necessary. Briefly, we see that the total induction in armature varies very slightly with lead and the displacement of the neutral plane decreases with lead angle, but varies less than 10 degrees from no load to the maximum load used.

All electromotive forces on one side of the neutral plane are of the same sign but differ in sign from those on the opposite side.

On a developed diagram the electromotive forces between collecting brushes would be proportional to the difference between the whole area of curve on one side of the line of commutation and the area of the curve included in the angle of lead, the lead angle being defined as the angular advance of the collecting brushes from the neutral plane. An inspection of the curve of total E. M. F. with angle of lead given in Fig. 6 shows that the E. M. F. between neutral points remains nearly constant as lead varies, which, it is believed, would not be the case if contracted polar faces were used instead of the extended ones as shown, for then the shifting of the field could not be so easily effected. Of course a machine of the design tested with extended pole tips requires an automatic widening of the brush with increased load or independent control of sparking, but it would seem that the waste field at all loads would be less and its weight efficiency greater, or cost for a given output less, than if its pole tips were cut away. Cutting away the pole tips, or at least not extending them, would have the advantage of allowing the use of collecting brushes of constant width within a certain range, but whether this advantage more than compensates for the decreased range of its output is open to question. Further experimental evidence is, however, needed in this regard.

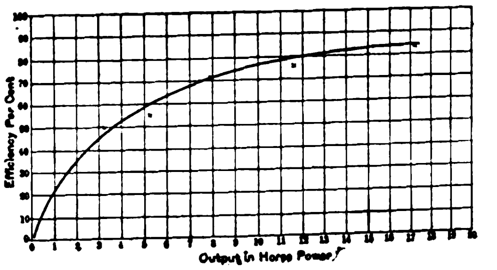

FIG. 10.

Regarding the relative amounts of iron in field and armature, we see no reason for the present practice of using so little iron in the armature as compared with the field. The necessity of a very high field induction, or a thoroughly stiff field, is apparent; but why, when the lines are once generated by the field, it is not sought to collect and utilize them all by means of an armature with a generous amount of iron is not so easily seen. The number of commutator segments would, of course, have to be increased to prevent sparking, but the regulating qualities of the machine would, it is believed, not be impaired. The result would be a larger output and greater efficiency.

Regarding the ratio of ampere turns on field and armature, such ratio will depend largely on the shape of the pole pieces and desired width of brush, but is in all cases much less than in constant potential machines.

The characteristic curves shown in Fig. 9 were taken at the 5, 10, 15, 20 and 25 light positions of the brushes, and show that with this machine regulation is almost entirely effected by shifting the brushes, as the curves droop too slowly to assist to any material extent. Of course they might have been made to droop much more rapidly if the collecting brushes had been moved into sparkless positions for each value of the current, but a curve so obtained is not at all a characteristic. The efficiency curve is given on Fig. 10. From this curve and from what we have seen of the machine it is evident that it would never pay to run machines of this type underloaded. If a number are used in one station the connections of the external circuits at the switchboard should be so manipulated as to keep the machines actually in use always loaded to as near their full capacity as possible.

Our thanks are due to Mr. H. J. Podlesak, who greatly assisted in taking the observations and working up the results.

Cost of Producing Electrical Energy.—II.

BY B. J. ARNOLD.[*]

The last portion of Table No. 2 [in last week's issue] is a synopsis of Table No. 1. Table No. 3 is the result of three tests made under the direction of the writer on a combined electric and lighting station, to ascertain the relative economy on oil and coal for fuel. Inasmuch as the information is quite complete, it has been thought advisable to insert it in this paper. The station consists of two compound condensing engines coupled directly to a line shaft. This shaft runs two 90 kilowatt railway generators, two 16 kilowatt arc light machines, two alternating incandescent dynamos of 30 and 50 kilowatt capacity respectively, or a total capacity of 392 kilowatts. The station is delivering but 1,248 kilowatt hours, showing that it is running considerably underloaded.

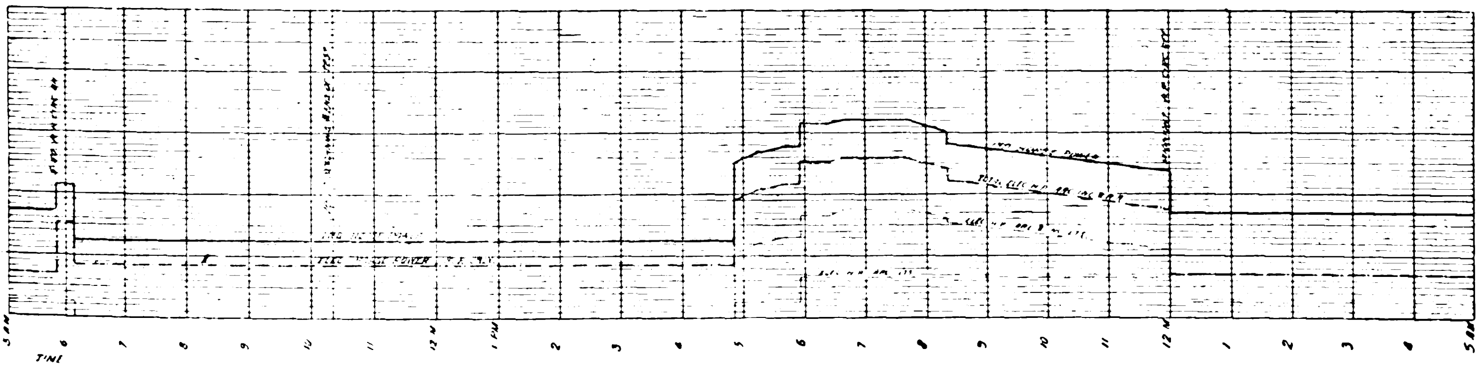

FIG. 1. COST OF PRODUCING ELECTRICAL ENERGY.

Fig. I

Figure No. 1 is a diagrammatic representation of the load during the twenty-four hours' run. The spaces between the vertical lines represent time and the horizontal lines horse power. The upper heavy line represents the total inclined horse power in the cylinders of the engine. The dotted line immediately below this represents the total electrical horse power delivered on the switchboard. The difference between these two lines represents the power lost in overcoming friction of engine, line shafting and the electrical losses in the dynamos. The third dotted line from the top represents the electrical horse power required by the arc and incandescent lights, and the lower dotted line represents the electrical horse power required by the arc lights alone.

Referring to Table No. 3, it will be observed that the test began at 10:20 A. M. and continued for twenty-four hours. As the load in this station varied greatly, one of the objects of the test was to ascertain the cost of producing power during the different periods, and the right hand column in the table shows the total cost per kilowatt hour of the power thus produced.

The railway portion of this station operates from four to six cars, and during the time of the test but four cars were in operation. The cars started at 5:50 A.M. and ran until 12 o'clock midnight, and the lighting load was added, as indicated by the figure.

The divison in the table shows the principal variation in the load, and it is interesting to note the change in cost per kilowatt hour produced, depending, of course, as it does upon the quantity of current delivered, as the cost remains practically constant, with the exception of the fuel. From 7:20 A. M. to 4:10 P. M., when the railway load is being operated, the cost averages 3.1 cents per kilowatt hour, and from 12 o'clock midnight until 5 A. M. the cost per kilowatt hour is 3.96 cents, while during the heavy load, from 5 P. M. until midnight, the average cost per kilowatt hour is but 1.75 cents, and after deducting the labor, which is a fixed charge, the total cost per kilowatt hour for full load is but 1⅓ cents. After allowing for salaries, office expenses, loss in lines and depreciation in the plant, the figures show that this station is delivering current to the consumer for 6.4 cents per kilowatt hour, which corresponds fairly well with the figures given in Table No. 2.

With a little calculation we see that this plant could have furnished 681 additional kilowatt hours, or over 90 additional horse power in motors, for ten hours from 6 A. M. to 6 P. M. for an additional cost of but $9 for fuel, or at a cost of 1 cent per horse power hour, and as a price of 2 cents per horse power hour can be obtained for motor work there would be an additional revenue of $9 per day added to this station, assuming that all the motors were running fully loaded.

As a matter of fact the following statement shows approximately the average amount of power demanded from electric motors when running on various kinds of work: Wood working machinery, 40 per cent. of rated capacity of machines in the plant; elevators, 80 per cent.; printing presses, 55 per cent.; machine shops, 40 per cent.; or an average of about 55 per cent. On this basis this plant could drive safely 160 horse power in addition to its present railroad load, which, at 2 cents per horse power hour, would bring an additional revenue of $33 per day, and deducting $9, the cost of fuel, leaves $24 per day additional net profit which this plant can be made to earn, provided the full capacity of the motors is paid for.

In case the additional load for electric motors is not available, this extra 90 horse power could be utilized in driving an ice plant. In practice it takes about 2 horse power twenty-four hours to produce a ton of ice, and on this basis the available capacity of this plant would produce 20 tons of ice, which would sell for at least $2 per ton, making an additional revenue of $60 per day for the plant, and after deducting for extra fuel, labor and depreciation, leaves $40 per day.

In closing this paper I will briefly call attention to the approximate results we are now getting from the different portions of power stations and what we ought to expect from stations designed in the future.

First—Boilers. A large number of stations running now are using boilers with plain furnaces, from which they secure an evaporation of 5 pounds of water per pound of coal. By the introduction of water tube or internally fired boilers or tubular boilers set in improved furnaces, we will secure an evaporation of 8 pounds of water per pound of the same fuel.

Second—Engines and Generators. While we now get an average commercial efficiency of 60 to 70 per cent. in directly belted plants and 50 to 60 per cent. in those using shafting, we can increase these efficiencies to 70 and 75 per cent. respectively by the adoption of fewer and larger directly coupled units. This will not only reduce the cost of fuel and labor but will decrease the amount of real estate required and make the total investment less.

Third—While Europeans have recognized the advantage of the use of accumulators with batteries as auxiliaries in central station work, we have been slow to see this advantage, but the tendency now among American engineers and central station men is to look with favor upon this adjunct, and as there are many cases wherein a battery plant as an auxiliary can be made to pay well, the probability is that we shall see in th next five years many such plants installed. With a properly designed directly connected plant, we may reasonably expect to deliver a kilowatt hour to the consumer in stations having a capacity of not over 1,500 kilowatts for 5 cents per kilowatt hour, which includes total cost of production and depreciation on the plant, but excludes interest on the investment and profit, assuming that a good quality of bituminous coal can be had for $2.50 per ton. In larger stations with cheaper fuel the cost can be brought to 3½ cents.

The Apparatus Won't Work.

The Colorado Springs Rapid Transit Company has brought suit in the U. S. Court at Denver against the General Electric Company for $20,000 damages. It is claimed that the apparatus sold to the defendant for its plant will not work, and the plaintiff has suffered great damage thereby.

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[*] Read before the Northwestern Electrical Association, St. Paul, July 19, 1894.

Electrically-Heated Cloth Presses.

An electric system of imparting a gloss to textiles has been patented at the works of J. Sarfert in Reichenbach, Saxony. The method consists in heating the press-plates by the electric current, which is conveyed into the p'ates by leading-in wires.

COST OF PRODUCING ELECTRICAL ENERGY.—TABLE III.

24 HOUR TEST ON COAL.	Av'ge Gauge Pres. Lbs.	Temperature		Duration Hours.	Average Watts.			Horse Power Electrical.	Horse Power Indicated.	Per Cent. Loss.	Total Fuel Lbs.	Total Ash Lbs.	Total Combustible Lbs.	Cost Fuel.	Water Total Used Lbs.	Evaporation Per Hour Lbs.					Com. H.P. 34½ lbs. water, hour 212°.	Cost per commercial horse power per hour fuel.	Cost of fuel for period.	Total cost operations, includ'g labor	Total cost fuel and labor per kilowatt hour produced.
		Feed Water.	Escaping Gases.		Railroad Circuit.	Incand's't Circuit.	Arc Circuit.									Actual Evaporation.	Factor Evaporation.	From and at 212°	Per Lb. Fuel Actual	Per Lb. Fuel Equivalent 212°.					
											Coal.														Cents
Feb 2. 10-20 A. M. to 4-10 P. M.	125	116°	640°	5.833	39215	...	......	52.56	...	.	3264	11.02 per cent.	......	$ Indiana block coal at 2.60 per ton.	20626	3536	....	4052	......	. .	117.5	. ...	$3.72	$7.11	3.10
4-10 P. M. to 5-45 P. M.	....	128°	680°	1.583	34100	34650	9180	104.46	.. ..	..	937		......		7019	4433	.. .	5082	.....	......	147.3	....	1.27	2.28	1.85
5-45 P. M. to 8-20 P. M.	....	118°	......	2.583	41360	38940	24140	140.00	......	...	2302		....		16849	6522	.....	7474	......	......	216.6	.. ..	3.04	4.13	1.53
8-20 P. M. to 12-00 M.	......	116°	......	3.666	26020	27170	24140	104.46	......	. . ..	2874		......		21028	5735	...	6571	......	......	190.5	....	3.79	5.33	1.87
Feb. 3. 12-00 P. M. to 5-50 A. M	.....	110°	620°	5.833	2572	15611	8160	36.56	......	...	3954				27845	4774	.....	5471	......	......	158.6	.... ..	5.03	6.26	3.96
5-50 A. M. to 7-10 A. M.	.. .	116°	......	1.333	24640	16500	......	55.14	...	......	1049		....		4344	3409	......	3907	....	......	113.3	....	.82	1.40	2.52
7-10 A.M. to 10-20 A.M.	125	118°	......	3.166	40480	.....	.....	54.20	......	......	1019		..		14437	4559	......	5225	......	.	151.5	......	2.60	3.97	3.08
For entire run	125	114°	635°	24.00	......	... ...	... ...	.....		.	15507	1719	13878	$20.27	112348	4686	1.146	5364	7.20	8.25	155.5	$.00543	$20.27	$30.48	2.45
24 HOUR TEST ON OIL.											Oil														
Feb. 6. 10-20 A. M. to 4-50 P. M.	125	126°	480°	6.500	29631	......	.....	42.2	63.3	33.2	1912	......	.....	C'st oil per gal $.01785 Cost oil per lb $.00253.	23806	3677	.. .	4184	.....	......	121.3	...	4.98	8.80	4.31
4-50 P. M. to 5-55 P. M.	......	124°	.. . .	1.083	32436	35420	9180	106.0	137.0	22.6	371	......	......		4944	4565	.....	5195	.....	....	150.6	....	1.03	1.81	2.13
5-55 P. M. to 8-20 P. M.	......	128°	520°	2.416	33573	39160	24140	128.0	158.0	19.0	1091	......	......		15244	6310	....	7180	......	......	208.1	....	3.18	4.19	1.58
8-20 P. M. to 12-00 M.	......	......	......	3.666	24192	27170	24140	100.0	130.0	23.2	1691	.....	......		10364	5282	......	6011	......	......	174.3	.... ..	4.04	5.58	2.03
Feb. 7. 12-00 M. to 5-50 A. M.	......	116	......	5.833	660	16500	9180	35.3	86.9	59.4	1992	......	......		23889	4096	......	4661	......	.....	135.1	....	4.98	6.20	4.06
5-50 A. M. to 6-07 A M.	....	124°	......	.283	23980	16500	9180	77.0	107.0	28.0	115	......	......		1648	5824	......	6627	.....	......	192.1	....	34	.40	2.50
6-07 A. M. to 10.20 A. M.	125	118°	......	4.216	33920	......	.....	42.2	63.3	33.2	1308	.....	....		14971	3551	......	4041	.....	......	147.2	....	3.12	$4.95	3.72
For entire run	.125	122°	....	24.000	......	.. ..	......	......	......	....	8570	.		$21.68	103956	4332	1.138	4930	12.13	13.80	142.9	$.006324	$21.67	31.93	2.83
Feb. 14 and 15 24 HOUR TEST Park Co. Coal.														$2.15 T.			As-s'med								
	.	......	...	24.00	.....		..	......	......	......	16930	2659	14271	$18.20	101854	4244	1.138	4829	6.016	6.846	140.0	$.005417	$18.20	$28.43	....

An Instrument of Extreme Sensitiveness.

Our esteemed English contemporary, *The Electrical Review*, in speaking of Dr. Oliver Lodge's new instrument for detecting Hertzian oscillations, has the following to say editorially, which is so well said and so clear that we give it in full instead of Dr. Lodge's own description which is longer and more technical:

"Prof. Oliver Lodge is a worthy continuator of the epoch-making work of the great Hertz. In his recent lecture at the Royal Institution he showed some interesting electric wave experiments with apparatus of remarkable simplicity and sensitiveness. As he remarked, 'the detector for Hertz waves might have been used in the last century; it might have been used by Benjamin Franklin.' The instrument which Dr. Lodge has devised for detecting electric waves he calls a coherer. It may be described as an electric welder on a very small scale, the electric welding being effected by the exceedingly minute currents produced at the contact of two pieces of metal by Hertz waves. Lodge had observed, in 1889, that two knobs, so close together that the air gap was unable to stand any such voltage as an electroscope can show, would actually cohere when a spark passed between them. The joint thus welded was capable of conducting an ordinary bell-ringing current if a single voltaic cell was in circuit, and required a perceptible amount of force to separate it. This arrangement has been developed by Lodge into an extremely sensitive wave detector. One terminal of an electric circuit, containing a single voltaic cell and a moderately sensitive galvanometer, consists of an iron wire which rests lightly on an iron plate attached to the other terminal. The instrument is most sensitive when the contact is sufficiently good to allow a very small current to pass. If electric waves are produced, say by charging and discharging an insulated sphere at some distance, the insulating layer at the contact of the coherer breaks down, and a considerable deflection is shown on the galvanometer. With this simple apparatus the reflection, refraction, polarization, and other optical properties of electric waves can be readily demonstrated. Electric oscillations in a sphere sixty yards distant have been indicated, and Dr. Lodge estimates that they would be detected half a mile away. The sensitiveness of the contact can be restored by tapping the plate.

"On these phenomena Dr. Lodge has founded an ingenious theory of vision. The retina of the eye is supposed to be furnished with cohesive contacts which allow an electric current to flow in the nerves when acted upon by the electromagnetic waves of light. Mechanical vibration supplied by the tissues restores the sensitiveness of the contact at intervals of a tenth of a second. A model has been constructed by Dr. Lodge to illustrate this theory. An electric bell or other mechanical vibrator is mounted on the same board as a tube of filings, which in this case acts as a detecter, and has its sensitiveness restored by the vibrations of the bell. This apparatus can be arranged so that a feeble electric stimulus produces a feeble, steady effect, and a stronger stimulus a stronger effect.

"The coherer is more sensitive to short waves than to long. The sparking at the contacts of an electric gas lighter will produce a marked effect, while heavy sparks from a large influence machine will not affect the instrument. Like the eye, the coherer has a limited range of wave lengths.

"This field of investigation promises results of great theoretical interest at least. Whether electric oscillations of these extremely high frequencies are ever to have any technical application is doubtful. The experiments of Tesla and others in this direction have not been promising."

Mr. McDonald Gets the Wenstrom Factory.

The Ft. Wayne Electric Corporation have leased the factory of the Wenstrom Company at Baltimore, and are thus equipped to enter the railway field at once.

Mr. R. T. McDonald has just returned from a trip to New Orleans, and reports his matters in that city in first-class condition.

Personal.

Mr. Chas. D. Shain is laid up at his home in Brooklyn, having suffered a serious injury to his leg through a fall sustained in jumping from a street car about ten days ago. He will not be about for several weeks.

Mr. Hugh Harrison, one of the Baltimore trolley magnates, was in New York for a few days last week.

Messrs. James H. Rhotehamel and A. C. Garrison, of the Columbia Lamp Company, were in town last week. Mr. Rhotehamel has returned to St. Louis, and Mr. Garrison has gone to Narragansett for a brief rest.

A Marvelous Discovery.

Inventions which are prophesied to revolutionize something or other are more plentiful than blackberries, especially in America. The latest electrical revolutionary discovery is recorded by a San Francisco paper, which gives the following very lucid description: "In the ground generator, they simply insert zincs and carbon directly in the ground without any containing vessel or cell, and saturated with a very weak solution of acids. Then, when the power of the generator begins to run down, all that is required to restore full electro-force is to add another supply of the fluid. By this means the carbons are depolarized without removing them from the ground, consequently the generator can be run day and night until the zincs are worn out."—*Electrical Engineer* (London.)

We are glad that this item has finally gotten abroad and been published. It was received by all of the electrical papers this side of the water, but none of them thought it worth while publishing it.

Trials of Oil and Gas Engines.

Engineering (London) describes the oil engine trials at the Cambridge Show of the Royal Agricultural Society, and gives a list of the exhibitors and the results arrived at. Crossley Brothers got a £25 prize, and R. Hornby & Sons a £50 prize, for fixed oil engines of 4 to 8 horse-power; while the Grantham firm also obtained a prize for the competition in portable oil engines of 9 to 16 brake horse-power. The various types of engines shown are more or less fully described by our contemporary.

Fan Motor Tests.

The Interior Conduit and Insulation Company have handed us the following document, which is the certified copy of the report of Messrs. D. C. Durland and S. Townsend of tests of Lundell fan motors. Twelve tests of each motor were made, with the results as given. The first two are of the Standard Lundell fan motor and show exceedingly gratifying results of economy. The extremely slow speeds given in the third test are explained by the fact that this motor is for a ceiling fan outfit and especially wound for slow speed:

FAN MOTOR TEST.

No. 560.				No. 562.			
No.	Speed.	Volts.	Amp.	No.	Speed.	Volts.	Amp.
1......	1700	115	.44	1....	1450	114.7	.86
2......	1670	115	.44	2....	1410	114.5	.83
3......	1780	114	.43	3....	1418	114	.87
4......	1750	114	.44	4....	1466	114.5	.87
5......	1800	115	.47	5....	1403	117	.81
6......	1650	115	.44	6....	1440	115	.83
7......	1730	115	.44	7....	1455	114	.87
8......	1760	114.5	.47	8....	1410	113	.83
9	1710	114.5	.46	9....	1405	114.5	.85
10......	1760	116	.46	10....	1405	115	.81
11......	1760	116	.45	11....	1395	115	.86
12......	1710	115.5	.44	12....	1408	115	.82
Mean..	1732	114.96	.44 5-6	Mean.	1422	114.7	.84¼

No. 568.

No.	Speed.	Volts.	Amp.	No.	Speed.	Volts.	Amp.
1......	112	115.5	.98	8....	112	114.5	1.00
2......	120	116	.99	9....	124	116	.98
3......	116	115	1.00	10....	116	115	1.02
4......	112	113	.98	11....	122	115	1.05
5......	112	114.5	1.00	12....	116	115	1.00
6......	116	114	.97				
7......	116	115	1.03	Mean.	116.16	114.89	1.00

All motors taken at random from stock.

Test made at the factory of the Interior Conduit and Insulation Company, 527 West 34th street, New York, July 16, 1894.

Test made by D. C. Durland and S. Townsend.

Above is true copy of report of test.

(Signed) CHAS. S. PEASE, Supt.

Chloride Accumulators in New York.

The New York Edison Illuminating Company has recently contracted with the Electric Storage Battery Company of Philadelphia for a large storage battery installation.

The installation will consist of 150 elements of chloride accumulators, Type G, 41 plates, having a capacity of 8,000 ampere hours at 150 volts at normal rates, or a total capacity of 1,200 kilowatt hours.

The installation will be furnished with the most modern and complete appliances for the control and operation of the battery, and everything possible will be done to make it a model and at the same time the most modern and complete battery plant ever installed.

The battery is to be installed immediately, to be ready for the heavy winter load.

The chloride company has also made a contract, we believe, with the Philadelphia Edison Company.

Queen & Company Fail.

As has been expected for several months, Queen & Company, Incorporated, of Philadelphia, have made an assignment for the benefit of their creditors.

The concern had been successful under individual management, but adds another to the long list of industrial enterprises which have speedily collapsed when capitalized and the ownership widely scattered.

Canadian Notes.

Secretary Rankine, of the Cataract Construction Company, Niagara Falls, has received official notice from President Langmuir of the Queen Victoria Park Commission that the preliminary plans of the power development on the Canada side have been approved by the commission and by the Ontario Government. This leaves the way open for continuing the work of preparation for constructing the power tunnel, wheelpits, etc., on the Canadian side.

The Toronto Railway Company have signed an agreement to purchase the Metropolitan Street Railway Company's property and charter. The sum specified is $76,000.

Orillia is to put in an incandescent light system, at a cost of $13,000.

The various representatives of the Standard, Chaudiere and Ottawa Electric Light Companies met recently and formally amalgamated the three companies into one, to be known as the Ottawa Electric Company. The officers elected were: President, Mr. T. Ahearn; vice-president, Hon. E. H. Bronson. The capital stock of the company is $1,000,000, with a paid-up capital of $645,000.

The Reliance Electric Manufacturing Company of Waterford, Ont., has assigned to R. S. Scott.

The Toronto Railway Company have recently purchased a lot in Parkdale, where they propose erecting a large power house, from which the Mimico and the Western electric roads will be worked.

Manager Griffiths of the Hamilton Street Railway Company is testing a plan to prevent electrolysis of water pipes. An extra wire has been placed on the rails on Guise street. Mr. Griffith thinks he will make a quick return current and overcome the difficulty.

The Canadian General Electric Company has accepted the franchise for lighting London, at the rate of 25 cents a night for each light. The present rate is 29½ cents, and the new offer means a saving of $3,500 a year.

Hamilton churches are entering protests against the running of Sunday cars, and a number of congregations have memorialized the street railway company to ask that the service be discontinued.

General News.

What is Going on in the Electrical World.

Wells, Minn.—This town has voted $20,000 for an electric light and waterworks plant.

Lynchburg, Va.—There is a strong sentiment here in favor of the city owning and operating an electric light plant.

Marion, Ohio.—An electric railway from this city to Mt. Vernon is likely to be built. It will probably pass through Adelaide and Mt. Gilead.

Boston, Mass.—The electrical equipment of the street railway between Boston and Brookline has been completed. It was formerly a horse line.

Marshall, Minn.—E. T. Sykes, of Minneapolis, has been awarded the contract for putting in a system of waterworks and electric lights for this village.

Reading, Mass.—At a special town meeting held in Reading, Mass., on the 7th inst., it was voted by a large majority to establish a municipal lighting plant at a cost of $50,000.

St. Augustine, Fla.—Bonds incorporating the St. Augustine and North Beach Electric Railway Company are about to be filed, and arrangements to establish the route are being made.

Paducah, Ky.—The city council has ratified a contract with the Consolidated Engineering Company of St. Louis for the erection of a plant for the lighting of the city by electricity.

St. Charles, Mo.—An ordinance granting A. D. Williams and G. O. McGee a franchise for twenty years to establish and operate an incandescent electric light plant has been passed by the council.

New York.—The Edison Electric Illuminating Company of New York reports for July: Gross earnings, $86,648; an increase of $5.773 over the same month last year; expenses, $46,920, decrease, $456.

Niles, Mich.—This city has purchased the Niles Electric Company's light and power plant for $37,500. The power is to be utilized, in addition to furnishing light, to furnish water for a new waterworks system.

Jackson, Tenn.—The committee appointed to solicit subscriptions for the proposed electric road in this city have made a favorable report to the board of trade, and there is every probability that the road will be built.

Asbury Park, N. J.—A trolley railroad is to be built between Asbury Park and Branchport, to connect with the steamboat running daily to New York. Senator James A. Bradley and H. C. King are mentioned as the leaders of the scheme.

Detroit, Mich.—R. A. Brett, the general manager at Detroit of the Harrison International Telephone Company, has opened an office in the Opera House block. The company will apply to the common council and mayor for a franchise.

Brooklyn, N. Y.—At the annual meeting of the stockholders of the Municipal Electric Light Company, held on the 7th inst., the following trustees were elected: Matthew Dean, John Hills, James L. Jensen, Clement Lockitt, Bernard Gallagher, Henry E. Hutchinson, Ezra D. Bushnell.

Doylestown, Pa.—The Bucks County Railway Company intend to construct a system of trolley roads in Bucks County. The incorporators of the company are Wm. J. Fell, of Marshall; S. Lynch, S. A. Hamilton and Robert C. Fulton, of Philadelphia, and Francis Fennimore, of Bristol.

Racine, Wis.—C. H. Holmes, president and treasurer of the Belle City Street Railway Company, has transferred all of his interest in the road to Jackson I. Case and Mr. Case in turn transferred all of his interest in the Green Bay electric road to Mr. Holmes. The latter will go to Green Bay and manage the road.

Rome, N. Y.—Bids for heating, plumbing and wiring for electric lights and plant for the new county almshouse at Rome will be received by the Building Committee until 1 o'clock Monday, August 20, 1894. Bonds with two or more sureties to the amount of 50 per cent. of their respective bids must accompany the bids.

Carbondale, Pa.—The Carbondale Traction Company's street railway line has been sold to the Lackawanna Valley Rapid Transit Company. The officers of the latter company are: President, H. B. Jadwin; secretary-treasurer, J. M. Nicol; directors, John W. Aitken, H. B. Jadwin, J. M. Nicol, E. E. Corey, Uniondale; H. J. Brennan, J. D. Stocker, J. M. Williams and William Walker.

Niagara Falls, N. Y.—A meeting of the Niagara Falls Power Company has been called for August 20 to take action on the proposition to increase the capital stock of the company from $2,600,000 to $3,000,000. The charter of the company limits the capital to $10,000,000, but up to the present time only $2,600,000 has been sold. The proposition is to increase the paid-up stock to 30,000 shares at a par value of $100.

Tarrytown, N. Y.—The New York, Elmsford and White Plains Railroad Company has applied to the commissioners of highways of Greenburgh for permission to construct and operate a railroad along the Tarrytown road to White Plains, the motive power to be electricity or any other power other than animal or locomotive steam power. The signers for the company are Hugh Reilly, Thomas Divery and James N. Landers.

Weymouth, Mass.—A movement is on foot to organize a company and run a line of electric cars from Shaw's corner, E. Weymouth, to the Braintree station of the N. Y., N. H. & H. R. R., a distance of about four miles. There are practical railroad men with plenty of money behind the enterprise and a large amount of stock has been taken by leading citizens of Weymouth and Braintree. The capital stock will be $40,000, and it is estimated that it will cost $10,000 a mile to build and equip the road.

Washington, D. C.—Representative R. A. Childs, of Illinois, presented in the House of Representatives on the 9th inst. a petition signed by ex-Solicitor Gen. Charles M. Aldrich, of Chicago, against pending bills, designed, he alleges, to extend the life of the Bell Telephone patents, which, from lawful causes, are about to expire. He goes extensively into telephone litigation before the Patent Office, and declares that legislation anticipating judicial determination of questions now pending "will cost the people many millions of dollars and perpetually fasten this monopoly upon the commercial interests of the country."

Rochester, N. Y.—Frank W. Hawley, who is deeply interested in the subject of electric propulsion for canal-boats, and has been an active participant in the experiments hitherto tried on the canal here, is quoted by an interviewer as saying: "The trolley plan is a success, I am sure, but just now we are fitting up another boat with a different apparatus. This is the storage battery system and with it we are equipping a canal boat which will be ready for trial about September 10th. The trial will be made between Albany and Troy and will prove which of the two systems is the more feasible for practical everyday service on the canal."

Parkersburg, W. Va.—George Stout, who has been with the Parkersburg Electric Company, has recently received a patent on an invention that promises to partly revolutionize the present system of arc burners and materially reduce their cost. As every one knows, the present arc lights use two sticks of carbon every twelve hours. Mr. Stout has invented a burner that is inclosed in a globe something like an incandescent burner, and consumes only one stick of carbon in two days. As these carbons cost three-fourths of a cent each, his discovery, whereby one stick will give the light which it required four to give heretofore, is a matter of great economy.

Chicago.—The prospectus of the Chicago and Suburban Elevated Railway Company, which has been issued for the information of property owners and others along the route of the proposed elevated railway, gives a description of the structure and running equipment, from which we take the following: "No windows will be darkened. The rails will be heavy, and, resting continuously on wood instead of at intervals, they will be kept smooth and free from resound, and the wheels being almost entirely enclosed in wood their noise will be deadened, and the electric motor being inclosed in wood the railway will be nearly noiseless. In the use of electric power, of course, there will be no smoke, ashes, or gas. Then all is compact as much as possible. Cars can be one foot narrower than ordinary horse cars, because standing room need not be provided, and the railway itself can be narrowed accordingly. The structure and cars and platform will be handsome and nicely painted. It will be but a single track railway, and always running one way; a second track can be added at any time, but if so it will be inaccessible except by a high bridge over the first track. Loop trains will consist of three short cars only, one being a motor car, seating thirty persons. Hence heavy motors will not be required, and, hence too, trains can stop and start and attain speed quickly. — Mortgages aggregating $4,500,000 have been executed by the Northwestern Elevated Railway Company, the North Chicago Electric Railway Company and the Chicago Electric Transit Company, to the Illinois Trust and Savings Bank.

Telescopic Iron Armored Insulating Conduit for Underground Work.

The telescopic insulating conduit with an iron armor, which we herewith illustrate, is the latest addition to the underground conduit system of the Interior Conduit and Insulation Company. The telescopic arrangement, whereby lengths of plain insulating conduit are slipped into lengths of the iron armored insulating conduit so that the sections break in the centers of the lengths, gives a double insulation, and at the same time an iron armor for protection. The lengths are coupled together by straight threading the ends, and abutting them in the center of the coupling, thus producing an underground conduit that is thoroughly waterproof, lasting and possessing the highest insulating qualities, so high, in fact, that bare wires can be drawn in with the certainty of perfect results. This system is complete in details, including junction boxes, etc., and is now in actual use in the underground construction of the Johnson-Lundell Electric Railway at East 69th street and First avenue, New York.

Telescopic Iron Armored Insulating Conduit.

The Mather Electric Company.

The Mather Electric Company of Manchester, Conn., have met with much success in the introduction of their new multipolar generator for electric lighting, and especially for electric railway work. The company has contracts for the installation of a number of these generators, some of which are of very large capacity, for railway work, both in the East and West.

The Mather Electric Company will shortly enter, with more activity than ever, into the railway field with these new generators, for belted or direct connected work, which have already proved so satisfactory. The company report signs of marked improvement in the electrical business, they now having on hand more work than at any other time for the last eighteen months. The recent sales of their standard belted, and also of their new direct connected apparatus, for lighting work, have been very large, necessitating a large addition to their working force in their works at Manchester. Mr. J. Holt Gates, 1140 Monadnock Building, Chicago, has met with flattering success in the West with the Mather apparatus.

INCORPORATIONS.

The North American Telegraph and Telephone Company of Oswego, N.Y.—to construct and operate telegraph and telephone lines from Brockport, Canada, to Alexandria Bay and to Oswego in New York State, and intermediate points about the Thousand Islands. Capital stock, $25,000. Directors: W. A. Poucher, C. H. Bond, O. McNally and J. B. McMurrich, of Oswego; M. H. Folger, B. W Folger and R. C. Carter, of Kingston, Ontario.

The Trojan Telegraph Company of Troy, to connect Troy by telegraph with Brooklyn, New Orleans, Memphis, Nashville, Louisville, Covington, Lexington, St. Louis, Roby, Ind.; Saratoga and Gravesend. Capital stock, $5,000. Directors: J. F. Cleary, J. W. Dwyer, M. J. Duffy, J. J. Cleary, F.H. May, E. H. Grennan and John W. Kenny, of Troy.

The Rockport Electric Power, Light and Heat Company, Kittery, Me.—to furnish light and heat by electricity in Rockport, Essex County, Mass. Capital stock, $50,000. President, Roger H. Tarr, of Rockport, Mass.; treasurer, Joseph B. Stevens, of Lynn, Mass.

The Gloucester and Rockport Street Railway Company —to construct a street railway from Gloucester, Mass., to Brier Neck. Capital stock, $40,000. Directors: D. S. Preston, A R. Hallowell, F. W. Homans and D. A. White, of Gloucester; W. B. Ferguson, of Malden, A. D. Bosson and J. H. Cunningham, of Chelsea, Mass.

The Savoy Advertising-Vending Machine Company of New Jersey, Jersey City, N. J.—to make, use and deal in all kinds of mechanical and electrical machines, instruments, etc. Capital stock, $200,000. Promoters: Jno. J. McDavatt, Pompton, N. J.; Geo. F. Rundle, Sparkill, N. Y.; Jerome Bradley, New York City, N. Y.

The Niagara Gas Saving Company (incorporated in W. Va.), Niagara Falls, N. Y.—to manufacture and sell gas and electricity to be used for fuel, heat, etc., under certain patents, etc. Capital stock, $16,000. Promoters: Wm. C. Edwards, Wm. H. Orchard, Judson D. Lapp, all of Niagara Falls, N. Y.

The Citizens' Light and Ice Company, Woodbury, N. J.—to manufacture, sell and supply electricity for lighting and power purposes, and to manufacture, buy and sell ice. Promoters; Hobart S. Clymer, Daniel J. Packer, Clarence C. Abbott, Woodbury, N. J.; Edward B. Williams, Philadelphia, Pa.; Franklin D. Springer, Bridgeport, N. J.

The New York Standard Construction Company of New York City—to construct and equip railroads, electric light plants, subways, waterworks, and to do various kinds of construction work. Capital stock, $50,000. Directors: Eugene Berry, of Rutherford, N. J.; Richard Krouse, Santiago Ping and Mark Sugarman, of Brooklyn, and William T. Zandt, of New York City.

The Hellersted Carriage Company, Fulton, Ill., has certified to an amendment of charter so as to do electric light business; also an increase of capital stock from $30,000 to $50,000.

The New York Standard Construction Company, New York City, N. Y.—to manufacture, sell and lease all kinds of electrical machinery and equipment. Capital stock, $50,000. Promoters: Eugene Berry, Richard Kraus, Wm. F. Z. Desant.

The Lackawanna Valley Traction Company, Scranton, Pa.—to construct and operate motors and cables or other machinery for supplying motive power to passenger railways. Capital stock, $400,000. Promoters: Louis A. Watres, Lemuel Anerman, Plumer S. Page, all of Scranton, Pa.

The Sandusky Valley Electric Railroad Company, Upper Sandusky, Ohio—to build and operate an electric railroad from Marion to Port Clinton, Ohio. Capital stock, $10,000. Promoters: Jno. O. Wirick, R. R. Dumm, F. E. Dumm, G. H. Roppold, Thos. Carroll.

The Pottsville Traction Company, Pottsville, Pa.—to construct, maintain and operate a street railway. Capital stock, $200,000. Promoters: J. L. Kaufman, New Cumberland, Pa.; L. S. Sadler, W. E. Sadler, Jr., Carlisle, Pa.

The Solano Electric Light Company, Benicia, Cal.—to do a general gas or electricity lighting and power business. Capital stock, $10,000. Promoters: Thos. McKay, Menneth Chisholm, Murdock McArthur, Pleates Fry, Benicia, Cal.; Geo. Frame, Elmira, Cal.

The Robertson Insulated Conduit Electric Company, at Chicago. Capital stock, $1,000,000. Incorporators: J. Luttrell Murphy, Smith H. Bracey, Hamilton B. McMillan, Bernis W. Sherman, William O. Osgood and Charles A. Dy.

The Electric Advertising Company, San Francisco, Cal. —to advertise by means of electrical and other devices. Capital stock, $100,000. Promoters: Fred'k Brandt, F. L. Waibel, Oscar Waibel, G. A. Paul, G. L. Schneider, Chas. E. Fisher, A. R. Paul, San Francisco, Cal.

The Eureka Electric Company, San Francisco, Cal.—to manufacture electrical apparatus and sell the same. Capital stock, $100,000. Promoters: Harper A. Smith, J. H. Lawrence, M. S. Lawrence, Alameda, Cal.; Arthur Hough, Edward A. S. Hough, Oakland, Cal.

The Housatonic Electric Light Company, which was chartered by the Connecticut General Assembly of 1893, has been organized and 20 per cent. of its capital paid in. Milo B. Richardson of Salisbury, Conn., has been elected president of the company.

The Monmouth Electric Traction Company, Red Bank, N. J.—to build and equip a street railroad from Red Bank to Long Branch. Capital stock, $300,000. Incorporators: William W. Conover, Daniel H. Applegate, Charles B. Parsons, J. Enright, Jr., William T. Parker, Robert Avery, J. W. Robinson, George W. Palmer and Thomas R. Woolley.

The United Telegraph, Telephone and Electric Company, Chicago. Capital stock, $1,000,000. Incorporators: Donald McDonald, John G. Earle and Edward P. McConnell.

The Central Bell Telephone Company of Venezuela, incorporated at Chicago—to build, operate and maintain telephone and electric light plants in Venezuela, South America. Capital stock, $400,000. Incorporators: Jacob K. Myers, Frank A. Amerman and Timothy J. Fell.

ELECTRICAL PATENT RECORD.

Letters Patent Issued August 7, 1894

ELECTRIC RAILROADS AND APPLIANCES.

524,014. Trolley-Wire Support. Levi Yakel, Allegheny Pa. Filed April 15, 1893. Renewed Dec. 27, 1893.

524,017. Trolley for Electric Cars. George C. Bourdereaux, Peoria, Ill. Filed March 12, 1894.

524,117. Motor-Suspension for Railway-Work. Edwin W. Rice, Jr., Lynn, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Aug. 15, 1889.

524,025. Conduit Electric Railway. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company of Connecticut. Original application filed Nov. 30, 1886. Divided and this application filed Sept. 12, 1891.

524,282. Electric-Railway Pole-Ratchet. Thomas J. McTighe, New York, N. Y., assignor, by mesne assignments, to Frederick K. Fitch, same place. Filed Jan. 23, 1893. Renewed Jan. 22, 1894.

524,283. Trolley-Wire Circuit-Breaker. Thomas J. McTighe and Sumner W. Childs, New York, N. Y., assignors, by mesne assignments, to Frederick K. Fitch, same place. Filed Jan. 23, 1893. Renewed Jan. 22, 1894.

ELECTRIC LIGHTS AND APPLIANCES.

524,003. Electric-Arc Lamp. George G. Stout, Parkersburg, W. Va. Filed June 19, 1894.

524,075. Reflector for Electric or Other Lamps. Ernest Tilmann, New York, N. Y., assignor of one-half to Charles K. Lexow, same place. Filed Dec. 1, 1893.

524,199. Rosette for Electric-Light Wires. Charles N. Hammond, Boston, Mass. Filed Dec. 7, 1893.

524,116. Electric-Arc Lamp. William S. Pendleton, New York, assignor to Edmund D. Davidson, Huntington, N. Y. Filed March 6, 1894.

MOTORS, DYNAMOS, ETC.

523,995. Electrical Motor. Henry B. Porter, New York, N. Y. Filed Dec. 5, 1893.

523,998. Dynamo-Electric Machine. Gustaf Rennerfelt, Lynn, Mass. Filed March 6, 1894.

524,011. Electric Motor. Frederic C. Whitmore, Lynn, assignor to the General Electric Company, Boston, Mass. Filed May 5, 1893.

524,020. Dynamo-Electric Machine. Rudolf Eickemeyer, Yonkers, N. Y. Filed Oct. 7, 1891.

524,119. Dynamo-Electric Machine. William B. Sayers, Glasgow, Scotland. Filed Jan. 6, 1894.

524,136. Regulator for Dynamo-Electric Machines. Thos. A. Edison, Menlo Park, N. J., assignor to the Edison Electric Light Company, New York, N. Y. Filed Nov. 11, 1881.

524,188. Electric Transformer. James J. Wood, Fort Wayne, Ind. Filed March 19, 1894.

TELEPHONE AND TELEGRAPH APPARATUS.

524,009. Telephone Annunciator and Call-Bell. Frederick G. Warrell, Philadelphia, Pa. Filed June 25, 1891.

524,118. Printing-Telegraph Instrument. James H. Rogers, Bladensburg, Md. Filed Dec. 12, 1893.

524,172. Variable Resistance Medium for Telephones. William W. Jacques, Newton, assignor to the American Bell Telephone Company, Boston, Mass. Filed May 14, 1894.

524,173. Variable-Resistance Medium for Telephones. William W. Jacques, Newton, assignor to the American Bell Telephone Company, Boston, Mass. Filed May 14, 1894.

BATTERIES.

524,229. Primary Battery. William Walker, Jr., Birmingham, Frank R. Wilkins, Handsworth, and Jabez Lones, Smethwick, England. Filed Feb. 27, 1894.

524,291. Primary Voltaic Battery. William Walker, Jr., Birmingham, and Frank R. Wilkins, Handsworth, assignors of one-third to Jabez Lones, Smethwick, England. Filed June 4, 1894.

SIGNALS AND SIGNALING APPARATUS.

524,038. Railway Signaling Device. William Daves, Jersey City, N. J., assignor of two-thirds to Samuel S. Bogart, Schraalenburg, N. J., and Benjamin Price, Baltimore, Md. Filed Aug. 3, 1892.

524,202. Electric Signal for Steamboats. Robert H. Gruschow, Chicago, Ill. Filed Jan. 30, 1894.

524,239. Submarine Signaling. Lucien I. Blake, Lawrence, Kan. Filed Dec. 22, 1893.

MISCELLANEOUS.

523,987. Electric-Welding Machine. Hermann Lemp, Lynn, Mass., assignor to the Thomson Electric Welding Company, of Maine. Filed Jan. 19, 1891.

523,986. Process of Electric Metal-Working. Hermann Lemp, Lynn, and Walter S. Moody, Chelsea, Mass., assignors to the Thomson Electric Welding Company, of Maine. Filed Oct. 20, 1890.

524,044. Electric Pump. Frank W. Merritt and Arthur R. Roe, Duluth, Minn., assignors to the Electric Motor Company, same place. Filed Nov. 6, 1893.

524,062. Electric Heater. Jesse F. Kester, La Grange, Ill., assignor to the F. P. Little Electrical Construction and Supply Company, Buffalo, N. Y. Filed April 29, 1893.

524,066. Waterproof Insulated Electric Conductor. Duncan Macfarlane, Philadelphia, Pa. Filed May 17, 1894.

524,098. Annunciator. Philip Weber, Nurenberg, Germany. Filed Jan. 16, 1894.

524,100. Supporting-Insulator for Electric Wires. Lauren S. Beardsley, Naugatuck, Conn. Filed June 11, 1894.

524,120. Electric Hand Appliance for Massage. Andrew J. Speare, Thayer, Mo., assignor of one-half to H. J. F. Davis, same place. Filed April 16, 1894.

524,121. Apparatus for Purifying Water or Aging Liquors. Robert C. Turner, Steubenville, Ohio. Filed Feb. 6, 1894.

524,156. Thermo-Electric Volatilizing Obtunder. Otto B. Bachman, Minneapolis, Minn. Filed April 6, 1893.

524,165. Circuit-Breaker for Electrotherapeutic Apparatus. Louis W. Downes, Providence, R. I. Filed Jan. 21, 1893.

524,250. Electric Sash-Balance. William C. Hodgkins, Washington, D. C. Filed Oct. 26, 1893.

ELECTRICITY.

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EDITORIAL NOTES.

The Development of the Electric Telegraph. In this issue Mr. Stephen Vail brings to a close his series of articles on the development of the electric telegraph which have proved so interesting and have attracted such wide attention. Mr. Vail has shown himself to be an accomplished *raconteur*, and the articles would have attracted attention from their literary merit alone, but they have an intrinsic worth beyond this. He has told, we believe, for the first time the true and unvarnished history of the telegraph, and as a historian has impressed his readers with a desire to be just and fair to all concerned. From his relation to Alfred Vail, whom he believes has not received justice at the hands of the public, it was to be expected that he would at times speak with warmth, and he has not disappointed expectations, but he has in all or nearly all such cases presented documentary evidence to justify his statements, and has thereby maintained his reputation for fairness, a violation of which at times, under the circumstances, would have been easily condoned. Not satisfied with having presented as he believed, an unbiassed statement of facts, he makes the following most graceful proposal:

> "Those who may have read citations I have made will have no difficulty in noting but one object, viz., to show just exactly what part in the invention of the telegraph each and every one connected with it should be credited for, nothing more and nothing less, and absolutely free from any wish or intention to deprive any of his just dues or to add one iota to the actual credit belonging to each one. If I have done actual injustice to any one, I shall be only too glad to make the *amende honorable* upon being shown my indiscretion."

In order to assist in carrying out his wishes we cordially invite any who disagree with him as to facts to make use of these columns, where their communications will be assured of the same publicity that was given the original statements. We believe Mr. Vail has intended to be entirely fair; it was certainly our intention to be so, and for this reason we invite the opinions of others who disagree with the statements we have published.

In reading this last chapter of Mr. Vail's historical sketch we are especially struck with two things. The first is that the Hudson River should have proved an obstacle to those who had already accomplished so much. It seems that the message was received at Fort Lee by wire and then *carried across the river by boat* to the residence of Audubon The question arises, why was not the message transmitted across the river by means of visual signals? The second point that strikes us is how little deviation in charges for service has been made since the first announcement, which reads as follows:

> "The following are the rates established for ten words and under: For the transmission and writing out of every communication not exceeding ten words, exclusive of the signature and address and the directions of the writer as to the disposition of the communication, from New York to Philadelphia, twenty-five cents. For every addition, not exceeding ten words, the same rate of charge as in the first ten.
>
> "AMOS KENDALL, President."

This announcement reads almost as it would were it signed by T. T. Eckert.

······o··

The Golden Rule in Business. The meeting of the Edison Licensees in Boston last week was an interesting one, and will be memorable in the annals of the Edison Association and of the electrical business. The papers were perhaps not epoch making, no new discovery in the science was here revealed for the first time. But the most startling fact of the decade, if not of the century, was made known on the last day of the meeting, to wit: that Mr. Coffin and the General Electric Company have always followed the Golden Rule in their treatment of the Licensees. We say the "fact" was made known. It must be a fact, because Mr. Coffin said so himself, said it boldly in open meeting, and Mr. Coffin being of Quaker training we are justified in assuming that the spirit moved him to say so.

Therefore we consider the statement of startling importance. We have always supposed, and we have the highest authority for our opinion, that religion is not out of place anywhere; that even the tone of cold business is elevated by the application of the teachings of religion. Few can be found to dispute this.

Now the whole world will be compelled to change its opinion. If the General Company's treatment of the Licensees has been in accordance with the Golden Rule, we must also suppose its treatment of its other customers and of its competitors has been governed by the same considerations; indeed, we know it, because no man can apply the teachings of the Golden Rule to the acts of his left hand and of some other rule to the acts of his right hand. A man capable of attempting to do this must be entirely ignorant of the Golden Rule itself.

Therefore it is simply necessary to point to the infamous character of this company's dealings, its violations of contract obligations, its attempt to drive all competitors out of business, its robbery of the investing public, its lying statements, its trampling upon all the principles of honest business which business men have ever held sacred, to show that the Golden Rule cannot be applied to business transactions by *honorable* men. If the General Electric Company's conduct has been in accordance with the Golden Rule, it would be far better to substitute the rule of the Devil, who we all know "takes care of his own."

Mr. Pecksniff also applied the teachings of the Golden Rule to his treatment of Tom Pinch—*so he said.*

……o……

The Outlook. The results of the business discussion at the Boston meeting of Edison Licensees cannot be foretold with certainty just yet. The feeling of the Association was not difficult to ascertain, the members apparently agreeing that secrecy is no longer a virtue in their affairs. The opinion is almost universal among them that there is nothing left worth tying to in the parent company unless the latter secures a favorable verdict in the lamp litigation which will be decided forever within the next few months.

In case it is finally held that the Edison lamp patent is ended this fall, we look for a speedy dissolution of all Licensee relations, save perhaps on the part of New York.

Since it has become known that the General Company is no longer protecting its Licensees in the matter of price. the resentment of the latter has increased, until some of the members can scarcely express themselves on the subject in temperate language.

The authorization of an examination of the books of the G. E. Company by the Executive Committee of the Association was a wise move. Instead of confining their attentions to the record of actual sales, which have been few, the committee will do well to secure copies of the many bids made up during the last eight months. They should also find out the reasons why several lamp factories were able to continue unmolested for months with the consent of the G. E. Company, and to the injury of the Licensees.

When this examination has been thoroughly done (and who is better qualified to direct it than John I. Beggs), and when the lamp patent is known to be ended, we expect to see the market of the Edison Licensee stations open to the world. Thus they can get better apparatus, better treatment, and better results.

……o……

N. A. A. S. Brooklyn during the past week has been in her glory entertaining the members of the National Association for the Advancement of Science. Brooklyn is very proud of her guests and is doing everything in her power to make their stay a pleasant one. We had hoped that we would be able to publish in this issue one or more papers of importance on electrical subjects, but as a matter of fact there is not an electrical paper on the programme. We have become so accustomed to feel that an article on electricity is necessarily a part of every scientific programme that we feel considerably disappointed not to find one included at this meeting, but the "professors" are showing us how they can conduct a successful series of meetings without mentioning electricity at all. It is to be hoped that before they depart for their homes they will relent and give us something really good.

Clothing-Man Hudson Talks Shop.

[From an interview in the Detroit Tribune on the lighting situation.]

"The Public Lighting Commission," Mr. Hudson said, "will not re-advertise for contracts as long as I am a member of the Commission. I will resign the minute it is done. The Commissioners are all agreed on their stand. We are business men, and have the best kind of electrical experience on our Board in the persons of Commissioners Jackson and Lothrop, who are experts, and City Electrician Dow, who is as competent an electrician as there is in the country. We are not there to act as cash boys, but to use our judgment, which we have done."

The Ideal Newspaper.*

In the *Forum*, Mr. William Morton Paine, associate editor of the *Dial*, sets forth as follows the duties he believes to be incumbent upon every newspaper conducted upon a high ethical plane :

"1. As a collector of news, pure and simple, its work should be done in the scientific spirit, placing accuracy of statement above all other considerations.

"2. In its selection and arrangement of the news thus collected it should have regard to real rather than sensational values ; it should present its facts in their proper perspective (which is still, of course, a very different perspective from that required by permanent history); and it should carefully exclude, or at least minimize to the utmost, those facts which it cannot possibly benefit the public to know, or of which the knowledge is likely to vulgarize popular taste and lower popular standards of morality.

"3 *In its comment upon the happenings of the day or the week it is bound to be honest, to stand for well-defined principles, to express the sincere convictions of its intellectual head and of those associated with him in the work.*

"In its accomplishment of the third of these fundamental aims," says Mr. Paine, "*the newspaper for which we are looking will have an editorial page that will compel attention*, that will really give its readers the guidance they have a right to expect. By means of this page the paper will fulfil the high function of a leader of public opinion, a function practically abdicated by the majority of our existing newspapers. *The editorial page is really the most important part of a paper, and upon it should be focussed the best intellectual forces at the editor's command.* One of the most noteworthy signs of the process of newspaper degradation that recent years have witnessed has been the steady deterioration of the editorial page. Only a few of the large newspapers have kept up the time-honored practice of serious leader writing ; *with the rest, editorials have dwindled into paragraphs, sounding the drone of the party politician or the flippant strain of the would be humorist.*"

[How closely does ELECTRICITY correspond to Mr. Paine's idea of the ideal paper, and how far do our contemporaries fall short of it !—ED.]

ANNUAL MEETING OF THE BRITISH ASSOCIATION.

(Special from our London Correspondent.)

The annual meeting of the British Association, which is this year being held at Oxford, was opened on Wednesday, August 8, under the presidency of the Marquis of Salisbury. The attendance was better than at last year's sitting, which was badly attended for various reasons, one of these being the absence of many prominent men from Europe on a visit to the Chicago Exhibition. There is not a great abundance of electrical papers this year, but most of those which have been communicated are of a very interesting character.

Lord Salisbury's presidential address dealt generally with scientific matters, one of his items being the "Inscrutability of the Ether." The following are his remarks on this subject :

"One of the most brilliant of the services which Prof. Maxwell has rendered to science has been the discovery that the figure which expressed the velocity of light also expressed the multiplier required to change the measure of static or passive electricity into that of dynamic or active electricity. The interpretation reasonably affixed to this discovery is that, as light and the electric impulse move approximately at the same rate through space, it is probable that the undulations which convey them are undulations of the same medium. And as induced electricity penetrates through everything, or nearly everything, it follows that the ether through which its undulations are propagated must pervade all space, whether empty or full, whether occupied by opaque matter or transparent matter, or by no matter at all. The attractive experiments by which the late Prof. Herz illustrated the electric vibrations of the ether will only be alluded to by me in order that I may express the regret deeply and generally felt that death should have terminated prematurely the scientific career which had begun with such brilliant promise and such fruitful achievements. But the mystery of the ether, though it has been made more fascinating by these discoveries, remains even more inscrutable than before. Of this all-pervading entity we know absolutely nothing except this one fact, that it can be made to undulate. Whether, outside the influence of matter on the motion of its waves, ether has any effect on matter or matter upon it is absolutely unknown. And even its solitary function of undulating ether performs in an abnormal fashion which has caused infinite perplexity. All fluids that we know transmit any blow they have received by waves which undulate backwards and forwards in the path of their own advance. The ether undulates athwart the path of the wave's advance. The genius of Lord Kelvin has recently discovered what he terms a labile state of equilibrium, in which a fluid that is infinite in its extent may exist, and may undulate in this eccentric fashion without outraging the laws of mathematics. I am no mathematician, and I cannot judge whether this reconciliation of the action of the ether with mechanical law is to be looked upon as a permanent solution of the question, or is only what diplomatists call a modus vivendi. In any case it leaves our knowledge of the ether in a very rudimentary condition. It has no known qualities except one, and that quality is in the highest degree anomalous and inscrutable. The extended conception which enables us to recognize ethereal waves in the vibrations of electricity has added infinite attraction to the study of those waves, but it carries its own difficulties with it. It is not easy to fit in the theory of electrical ether waves with the phenomena of positive and negative electricity, and as to the true significance and cause of those counteracting and complementary forces, to which we give the provisional names of negative and positive, we know about as much as Franklin knew a century and a half ago."

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* Extract from *The Review of Reviews.*

In Section A, on 9th inst., Prof. A. W. Rucker, M. A., F. R. S., read his opening address on "Mathematics and Physics," and on the same day, in Section G, Prof. H. B. Dixon, M. A., F. R. S., read a presidential address on chemistry. Section C was presided over by L. Fletcher, M. A., F. R. S., F. G. S., and in the course of his address made the following remarks on electrical matters :

Piezo-Electricity.—The most remarkable addition to our knowledge of the relation of minerals and electricity has been the recent discovery of the electrification produced by strain (piezo-electricity). It has been shown by J. and P. Curie that if a quartz-plate, with faces cut parallel to the axis and silvered to make them conductive, be strained in a certain direction, the two faces either become oppositely electrified or show no sign of electrification at all, according as the faces of the plate are cut to be perpendicular to the prism-faces, or to pass through the prism edges. Lord Kelvin says that this result is explicable by electric-eolotropy of the molecule and by nothing else, a character which he had suggested for the molecule thirty-four years ago; experiments confirmatory of this hypothesis of the permanent electrification of the molecule were made some time ago by Riecke.

Pyro-Electricity.—The development of opposite electricities at different parts of a crystal during changing temperature (pyro electricity) has long been known in the case of tourmaline. We owe to Hankel a long series of investigations of this kind relative to boracite, topaz and various other minerals, but it seems to be now established that most of the electrifications observed by means of his method are really piezo electric, and are due to strains caused by inequality of temperature in different parts of the cooling crystal. A model has been lately made by Lord Kelvin which gives a perfect mechanical representation of the elasticity, the piezo-electricity, and also the pyro-electricity of a crystal.

Electrical Methods.—A delightfully simple method of investigating the difference of electrical condition of the parts of a cooling crystal and of making the distribution of electricity visible to the eye has been invented by Kundt. Mixed particles of (red) minium and (yellow) sulphur are oppositely electrified by their passage through the meshes of a small sieve; falling on the cooling crystal, each particle adheres to the oppositely electrified region, and the electrical condition of the latter is thus immediately indicated by the color of the adherent powder. Mr. Miers remarks that this method is practically useful as a means of discrimination even when the crystals are extremely minute.

Legal Notes.

An execution has been issued against the Scott Electrical Manufacturing Company, at 126 Liberty street, New York, manufacturers of the Huntington electric searchlight, for $14,311, in favor of Frederick E. Guy on seven demand notes of the company, made between Oct. 30, 1890, and June 26, 1894, to the order of Mrs. Eleanor C. Huntington, who was the treasurer and financial backer of the company.

Two suits have been brought in the U. S. Circuit Court at Minneapolis by the General Electric Company of Schenectady, N. Y., and the Thomson-Houston Electric Company of Connecticut against the International Electric Company of Minneapolis, asking that the latter company be restrained from using a device the patent for which is alleged to have been first granted to Edison and then to Elihu Thomson. In addition to the injunction the Schenectady company asks for accrued profits.

THE EDISON LICENSEES.

Annual Convention at Boston.

The Association of Edison Illuminating Companies met in annual convention at the Hotel Vendome, Boston, on Tuesday and Wednesday of last week.

The programme, as published in ELECTRICITY two weeks ago, comprised several interesting papers, none of which, it is understood, will be printed except in the official transactions of the body.

Five new members were added, and also three who had dropped their membership, showing that interest in the Licensee question has increased.

The most valuable papers were those of Mr. Barstow on the "Low Tension Arc Lighting System," in which he referred in very complimentary terms to the new twin lamps of the Electric Construction and Supply Co.; Mr. Van Vleck, on the Switchboard of the New York Edison Station, equipped with the Weston "edgewise" instruments, designed by Mr. Van Vleck; and Messrs. Broker and Lieb on Storage Batteries for Central Station Work.

Outside of the regular papers there was a spirited discussion on the relations existing, or supposed to exist, between the Licensees and the parent company. Mr. John I. Beggs introduced the matter on Tuesday, and it was at once perceived that he was in fighting humor. After a few remarks from Mr. Beggs the matter was laid over till Wednesday. Meantime Mr. Coffin was advised, and on Wednesday he was on hand to hear a severe arraignment of the policy of the parent company, its violation of contract obligations, the failure to protect the Licensees in their territory, and the sale of apparatus to outsiders at lower prices than to the Licensees. Mr. Beggs was almost violent in his manner, and his contentions were unanswerable.

Judge Armstrong, of Camden, also joined in the attack, having recently come into control of the Licensee station at Atlantic City, in whose territory T.-H. incandescent apparatus has been sold by the General Electric Company. Judge Armstrong was more moderate in tone, but his argument was none the less effective.

Mr. Coffin was evidently shocked and pained. In his brief reply he said little of interest, except to assert that the General Electric Company had always followed the Golden Rule in its treatment of the Licensees and would continue to do so. His address lasted about fifteen minutes.

Following this the Executive Committee was given authority by the Association to take any measures deemed necessary to protect the rights of the Licensees, and to examine the books of the General Company and see for themselves what had been done.

The following officers were elected :

President—Charles L. Edgar, vice-president and general manager of the Edison Electric Illuminating Company of Boston.
Vice-president—A. L. Smith, Appleton, Wis.
Secretary—W. S. Barstow, Brooklyn, N. Y.
Treasurer—J. W. Lieb, New York City.
Executive Committee—John I. Beggs, chairman; C. B. Gilbert, Detroit, Mich.; E. R. Weeks, Kansas City, Mo.; W. D. Marks, Philadelphia, Pa.; E. R. Stetson, New Bedford, Mass.; C. L. Edgar, Boston, ex-officio.

The next convention will be held at Detroit on August 14, 1895.

The following gentlemen were present :

W. M. Anthony, Chicago Edison Co., Chicago, Ill.
E. A. Armstrong, Camden Electric Light Co., Atlantic City, N. J.
W. S. Barstow, Edison Electric Illum. Co., Brooklyn N.Y.
M. A. Beal, Forest City Electric Light and Power Co., Rockford, Ill.
George Cato, Detroit Illuminating Co., Detroit, Mich.
W. S. Clark, General Electric Co., Schenectady, N. Y.
J. A. Colby, Des Moines Edison Light Co., Des Moines, Ia.
C. L. Edgar, Edison Electric Illum. Co. of Boston, Mass.
H. T. Edgar, Edison Electric Illum. Co. of Atlanta, Ga.
W. L. R. Emmet, General Electric Co., Schenectady, N.Y.
Louis A. Ferguson, Chicago Edison Co., Chicago, Ill.
A. W. Field, Edison Electric Light Co., Columbus, O.
W. H. Francis, Edison Electric Illum. Co. of Boston.
C. P. Gilbert, Detroit Illum. Co., Detroit, Mich.
S. D. Greene, General Electric Co., Schenectady, N. Y.
R. S. Hale, Edison Electric Illum. Co. of Boston.
Caryl D. Haskins, General Electric Co., Boston.
A. L. Hawley, Union Electric Co., Seattle, Wash.
Albert B. Herrick, General Elec. Co., Schenectady, N. Y.
Chas. T. Hughes, General Electric Co., New York.
F. E. Jackson, Edison Electric Illum. Co., Brooklyn, N.Y.
W. J. Jenks, General Electric Co., New York.
A. E. Kennelly, Philadelphia, Pa.
A. S. Knight, Edison Elec. Illum. Co. of Boston.
J. W. Lieb, Jr., Edison Electric Illum. Co. of New York.
R. Lindsay, Cleveland Elec. Illum. Co., Cleveland, O.
J. R. Lovejoy, General Electric Co.
John R Markle, Edison Light Co., Grand Rapids, Mich.
William D. Marks, Edison Elec. Illum. Co., Philadelphia.
J. Willard Morgan, The Electric Light Co. of Atlantic City, Camden, N. J.
I. E. Moultrop, Edison Elec. Illum. Co., Boston.
A. D. Page, General Electric Co., N. Y.
Charles E. Pattison, Edison Electric Illum. Co., Boston.
A. G. Pierce, Edison Electric Illum. Co., Boston.
Chas. R. Price, New Bedford Gas and Edison Light Co., New Bedford, Mass.
J. B. Pyle, Edison Electric Illum. Co., West Chester, Pa.
Warren B. Reed, Edison Electric Co., New Orleans, La.
Howard Rinck, Edison Electric Illum. Co., Easton, Pa.
A. L. Smith, Appleton Edison Elec. Co., Appleton, Wis.
George R. Stetson, New Bedford Gas and Edison Light Co., New Bedford, Mass.
N. C. Stevens, Edison Elec. Illum. Co., Brockton, Mass.
Luther Stieringer, New York.
Adolph Theobald, Edison Elec. Light Co., Columbus, O.
Francis A. Upton, General Electric Co., Harrison, N. J.
J. Van Vleck, Edison Electric Illum. Co. of New York.
E. R. Weeks, Edison Electric Light and Power Co., Kansas City, Mo.
Charles Wirt, Chicago, Ill.
W. H. Wofrekamp, Edison Electric Illum. Co., Lawrence, Mass.
John Wolff, Edison Co., Brooklyn, N. Y.
E. W. Rice, Jr., Schenectady, N. Y.
P. H. Alexander, Electric Selector and Signal Co., N. Y.
R. B. Corey, Electric Construction and Supply Company, New York.
Sigmund Bergmann, General Incandescent Arc Light Co., New York.
P. H. Klein, General Incandescent Arc Light Co., New York.
H. W. Weller, Solar Arc Lamp Co., New York.
H. S. Kaliske, Beacon Lamp Co., Boston.
F. B. Parsons, Davidson Ventilating Fan Co., Boston.
George J. Jackson, Norwich Insulated Wire Co., New York.
George M. Phelps, "Electrical Engineer."
R. R. Ross, "Electrical World."
F. L. Perry, "Western Electrician."
B. E. Greene, "Electricity."

SIEMENS & HALSKE.

On Monday, the 13th, a large force of Siemens & Halske employes were put to work in the Grant Locomotive Works, which the company has secured for factory purposes.

The company have lost no contracts by reason of the stoppage of its business by fire, but have taken several new ones. They will be better equipped than before in their new quarters.

End of the Fight in Detroit.

The contracts of the city of Detroit with the Western Electric Company for dynamos, and with the Brush Company for lamps, for the municipal plant, have at last been confirmed by the City Council. The Lighting Committee of the latter body, whose wishes were not respected in the matter, thereupon resigned.

This probably ends the contest and the plant will now go forward.

More Lamp Factories Closed.

Judge Ricks, at Cleveland, has granted temporary injunctions against the Orient Electric Company and the New York Electric Company, both concerns making lamps at Youngstown, O.

The General Company had agreed to allow the Orient factory to continue unmolested as consideration for the purchase of a dynamo from the former company.

Distribution of Electrical Energy by Alternating Currents.*

We have received the following description of Mr. W. Lowrie's intraposed automatic system of electrical distribution:

Experience has shown, and it has come to be generally admitted, that the present methods of distributing electrical energy over large areas and of safeguarding the circuits are open to great improvement. After years of patient work and the trial of many systems of distribution, only two now practically hold the field. The simple parallel or low-tension system, at once the most simple and safe, is unfortunately limited to a very small area of supply. A modification of the low tension, called the three-wire system (which is in reality a series parallel system), has been extensively used with a view to increase the low-tension area of supply. The application of this and other cognate systems must, however, inevitably grow less and less as the use of electricity becomes more general throughout the country and the densely populated quarters of large towns or districts are supplied with it. The public opposition to the erection of electric lighting stations in crowded areas has already been so great that any attempt to sufficiently increase their number in order to cope with anticipated public requirements is sure to be stoutly resisted, and the time is not far distant when they will no longer be tolerated in such places as we now see them.

The enormously increasing difficulties met with in all endeavors to extend the low-tension system to meet the demands over even moderate areas of supply have driven electrical engineers, in order to obtain economy, commercial efficiency, and comply with the Board of Trade requirements, to adopt the high-tension system of distribution with transformers, to reduce the pressure to the limits imposed by it and the requirements of translating devices. A short *resumé* of the progress of the high-tension system, taking it step by step, and illustrating these steps by diagrams, showing how it gradually advanced to the position now claimed for it by its supporters, will help to a better understanding of them and a just appraisement of their value.

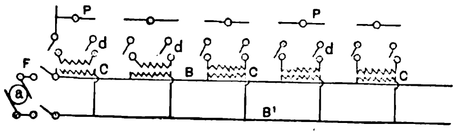

FIG. 1.

When the high-tension parallel system was first installed, a pair of high-tension mains were laid throughout the area of supply, and converters connected in parallel were placed on the premises to be lighted, and secondary mains installed for the low-tension supply to the lamps taking current direct from the converters, as shown in Fig. 1.

It was, however, soon found that when small installations and many of them were connected to the circuit, each with its own small converter, the magnetizing current at the time of light loads was nullifying the advantages gained by the use of high tension. It was in consequence changed in many places to the form described in Fig. 2, which shows several premises served from one large converter fixed in one of them; in other words, more than one house was dependent on one transformer. This led to connecting the transformers together by pairs of compensating or secondary mains, and connecting the house circuits (not shown) to these mains, instead of direct from the converters, as shown in Fig. 3, thus making every house dependent on more than one transformer, and converting the system into a compound system of high and low tension. This, though a great step forward towards the solution of the electrical distribution problem, did not do away with the many serious difficulties encountered when transformers were working in parallel, or the magnetizing current losses, or enable transformer or high tension connections to be made without stopping the supply over the whole circuit, or the great danger run by the operatives while testing or repairing it.

This led to the sub-station system (Fig. 4), which consists of a high-tension supply to a number of converters, placed in a suitable building, and a low tension system diverging from these converters. Any converter could be cut out by hand, thus saving the magnetizing current; but the same laws that condemn the simple low-tension supply apply equally here, and the cost of the low-tension system from the sub-station is found to be prohibitive except in very densely populated towns or districts, and recourse has here again been had to the three-wire system.

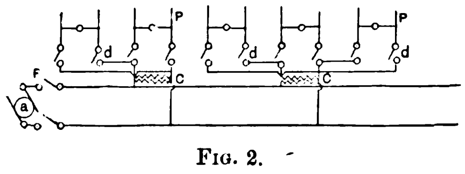

FIG. 2.

A further development consists of a system sufficiently illustrated by Fig. 3, but here the converters are either in the roadway or in elevated street boxes, or on walls of houses, so that an attendant is required to go round and turn off both high and low tension from the converters. This is manifestly both a dangerous, expensive and unreliable method, so that it has been suggested to switch the primary at the central station. This control of the primary supply over the area brought with it the necessity of controlling the secondary windings of the converters so that they could be severed from the secondary or distributing system, to which all converters are connected in parallel. It has been proposed to accomplish this by hand-worked switches at the converters; this is not practicable where immediate control is required to meet the exigency of a variable demand. It has also been proposed to accomplish the same object by separate control wires run from the central station to each converter, but the obvious expense, complication and difficulties of such a system will prevent this method being used. Added to the disadvantages just referred to, none of the systems mentioned provide against a most serious danger to all electrical machinery working in parallel, either alternators or converters—that is, the risk in case of the failure of any machine on the circuit that the failing machine will cut out the fuses of the sound machines instead of its own, and thus break down the whole system; nor yet do they make provision for immediately reconnecting the failing machine if it should be restored. Further, in case of any hand-worked switch being inadvertently left on the primary main, although switched off at the station, would remain charged at full pressure by the back action from the secondary mains through the converter so left on. The same danger occurs in mains working in parallel, as should two mains of different signs make accidental earth at one time they would form a short circuit and blow out the fuses of both circuits.

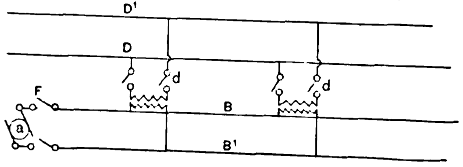

FIG. 3.

The latest of these developments is the compound intraposed automatic system recently designed by Mr. W. Lowrie. It is claimed that Lowrie's compound intraposed automatic system completely removes the foregoing and all other difficulties hitherto met with and obtains both safety, economy and easy control of electric current circuits, where two or more units of supply apparatus are worked in parallel, as in the examples following:

(*a*) Two or more primary generators, working in parallel, directly supplying a distributing system of mains; (*b*) two or more primary generators, working in parallel, supplying a transformer or group thereof; (*c*) two or more primary generators, working in parallel, supplying two or more transformers, whose secondary windings are connected in parallel to a distributing system of mains; (*d*) two or more feeder mains, each supplied from a separate source, feeding in parallel a distributing system of mains; (*e*) two or more feeder mains, supplied from a common source, feeding in parallel a distributing system of mains; (*f*) two or more feeder mains, supplied from a common source, feeding the primary circuits of transformers; (*g*) two or more feeder mains, each supplied from a separate source, feeding transformers which are arranged in parallel to supply a distributing system of mains; (*h*) two or more transformers, arranged in parallel, to supply a distributing system of mains.

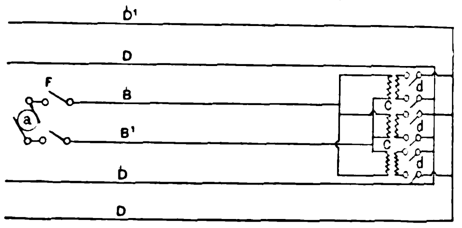

FIG. 4.

By the accompanying drawings it will be seen that Mr. Lowrie, in his compound intraposed parallel system of electrical distribution, places converters at intervals on the line of mains covering the area to be supplied buried in the road, or in chambers in the roads, or on the premises to be supplied (or some of them), and connects the primary winding of the converters alternately to two or more separate pairs of mains or conductors coming direct from the switchboard at the generating station, or other suitable place, as shown in Figs. 5 and 6. The converters being so arranged on the said sub-divided primary mains (the aggregate of such mains as to sectional area of copper being only equal to that of a single pair) that a converter or group of converters, or a number of converters or groups of converters, at intervals along the line of mains can be cut out by suitable switching apparatus at the central or other station, and the converters separated from the secondary supply mains by an automatic controller switch placed in circuit with each converter or group thereof, the action of the controller being called into play by the act of making or breaking the primary circuits of the converters to which they are attached, whether the same be purposely or accidentally done. It is proposed to place controllers near each alternator to protect them and the system in case their pressure should fall below the required voltage.

Figs. 7 and 8 are diagrams of one form of Lowrie's automatic controller switch, with electric connections thereto, adapted for use with alternating or interrupted currents, the difference between them consisting mainly of an extra shunt winding in Fig. 8, which may also be used with continuous currents. Figs. 5 and 6 are also diagrams, indicating the relative positions of the said switches in a sub-divided system of mains for the distribution of electrical energy, Fig. 5 being adapted for alternating currents only.

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* From "The Electrical Engineer" (London).

In these diagrams A A^1 indicate the omnibus bars, or their equivalents, in a station fed by generators, *a a*^{1}. Two or more separate mains, B B^1 and B^2 B^3, are connected directly to the bars, A A^1, at the station, and thence are connected alternately to the primary windings, *b b*^{1} and *b*^{2} *b*^{3}, of two or more transformers or converters, C and C^1. The secondary windings, *c c*^{1} and *c*^{2} *c*^{3}, of the said transformers, are connected to the distributing system of mains, D D^1, which connect together the secondary terminals, *d d*, of the transformers, and all the supply or lamp wires are joined to the distributing mains, D D^1.

When the primary circuit, B, for example, is put in action at the station, by hand at F, or otherwise, the automatic switch, E, operates to put the secondary terminals, *d d*, of the transformer, C, in connection with the distributing mains, D D^1, and consequently with all the supply wires joined thereto. If the load increases the second converter shown, C^1, is similarly put into action at the station by joining up the primary circuit, B^2 B^3, with the bars A A^1, and the same method is employed with any other converters, similarly arranged, that may be on the circuit D D^1. Each converter, C, shown on the drawings is intended to represent either a single converter or a group of converters fed by a separate primary main or conductor, whatever may be the number of converters in the group. These converters, or groups of converters, may be added along the same line of mains at intervals indefinitely, and these primary feed mains, B B^1, may be laid close to, though insulated from, each other, so that the primary current may be operating in one pair of conductors and not in another pair adjoining thereto, or they may have a common return.

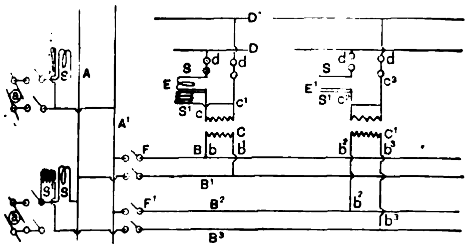

FIG. 5.

In the diagram, Fig. 7, of the automatic controller switch, E, an electromagnet is shown having two limbs pivoted together at *e*, one limb, *e*^{1}, being rigidly fixed, the other limb, *e*^{2}, being pivotally movable on the joint *e*. Polar projections are formed in any convenient manner, and the core is laminated. The movable limb, *e*^{2}, carries four contact-pieces, *h* (suitably connected to the secondary circuit, *c c*^{1}, of the converter, E, as in Figs. 5 and 6, for example), operating simultaneously in one direction, and two contacts, *j*, operating simultaneously in the opposite direction. These are so arranged that when the contact pieces *h* are in circuit, the contact-pieces *j* are out of circuit, and conversely when the latter are in circuit the connection is broken at all four of the *h* contacts. The several *h* contacts each form a pole switch on the mains, and all the parts are suitably insulated, as is well understood by electricians. The other two contact pieces, *j*, when in circuit, form a short circuit for a series coil, S, through the circuit, *n n*, in Fig. 7, and connect a cross-wound shunt in Fig. 7.

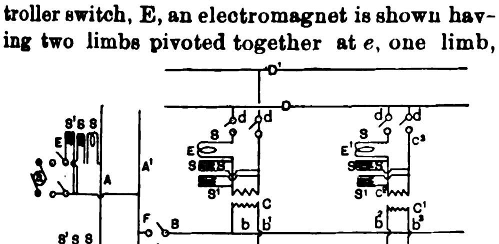

FIG. 6.

In these controller switch diagrams, Figs. 7 and 8, the mains, A A^1, are to be taken as feeder mains to the controller, whether supplied from a primary or secondary source, and D D^1 the distributing mains, fed by two or more sources (primary or secondary) of electrical energy. The series coil, S, is connected by the circuit L L to work in series with the main circuit, A A^1, while the shunt coil, S^1, is placed across the circuit by the conductors, M M^1. The action of the switch, as shown in Fig. 7, is as follows: the circuit is closed on the right-hand side at all the *h* contacts, the feeder mains, A A^1, being in action on the distributing mains, D D^1. The current in the feeder mains, A A^1, is designedly a little lower in E. M. F. than that in the circuit D D^1, but the voltage is increased to that in the circuit D D^1 (after passing the switch) by the action of the shunt coil, S^1, upon the series coil, S, which is in series with the feeder mains, A A^1, from which it will be seen that the electromagnet, E, acts as an auxiliary transformer. The series and shunt coils, S and S^1, are adapted to produce poles of the like name, and when this occurs the movable limb, *e*^{2}, is repelled, the contacts *h* are made, and the short-circuit contacts, *j*, are broken, as shown in the drawings, Figs. 7 and 8. When the current potential falls in the feeder mains, A A^1, from any cause, and so fails to maintain its power to feed the distributing mains, D D^1, then the direction of the current through the series coil, S, will be reversed (through the higher back E. M. F. from the mains, D D^1, fed by other sources in parallel), while the direction of current in the shunt coil, S^1, would remain the same—thus bringing about unlike poles of the limbs, *e*^{1} *e*^{2}, with mutual attraction, which, breaking all the contacts *h* in one direction would make the *j* contacts in the opposite direction, and short-circuiting the series coil, *s*, through the circuit, *n n*, the feeder mains, A A^1, and both series and shunt coils, S and S^1, are rendered dormant.

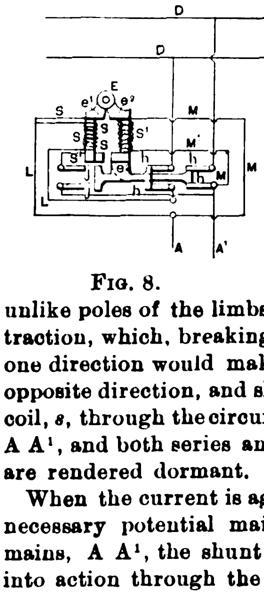

FIG. 8.

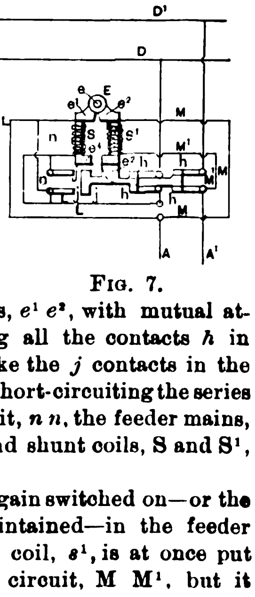

FIG. 7.

When the current is again switched on—or the necessary potential maintained—in the feeder mains, A A^1, the shunt coil, *s*^{1}, is at once put into action through the circuit, M M^1, but it could not act on the series coil, S, if it were not for the short-circuit contact, *j*, as the said coil would be on open circuit. The short circuit, therefore, will admit of a strong current being induced in the coil S, which, producing like polarity in the limb *e*^{1} to that of *e*^{2}, repels the latter or movable limb—thus making good all the *h* contacts, and breaking that of the short circuit, *j*, makes all the circuits good for feeding the distributing mains, D D^1.

Fig. 8 is a diagram of an automatic switch and its connections adapted for working with either alternating or continuous currents. The arrangement is similar to that of Fig. 1, and the description of the latter will apply likewise to Fig. 2, with the exception that the short circuit upon the series coil S, by the line *n n* is omitted and replaced by the shunt coil *s*, wound on the same limb, *e*^{1}, as the series coil S, while its circuit (the circuit of *s*) is made or broken at *j*. The connections are so made when using continuous currents that when the mains, A A^1, are put into action the two shunt coils, S^1 and *s*, by producing like poles, repel each other, and so make good the circuit through the contacts, *h*, and series coil, S, while at the same time the second shunt coil circuit is broken. On the other hand, on the cessation or reduction (to any required degree) of potential energy in the feed mains, A A^1, a reversal of current takes place in the series coil, S, thus bringing about unlike poles of the limbs *e*^{1} *e*^{2}, with mutual attraction, consequently breaking the *h* contacts, and making the *j* contacts as before.

Fig. 9 is a drawing of a 200 ampere controller for use with transformers, the reference letters remaining the same as in the foregoing, with the following additions: K, connecting pieces of hard copper; O, stop and guide for moving arm; T, terminals for cable connection; *t*, dummy terminals to carry contact pieces, *h*, where T are not required; D and D^1 are cables leading thereto. It is to be noted that solenoids only may be employed instead of the electromagnet described, and that the limbs or coils referred to may be reversely arranged, or even both limbs movable, or any other mechanical arrangement may be used embodying the electrical principle entailed without departing from the nature of this invention. The advantages claimed for the Lowrie compound intraposed automatic system are as follows:

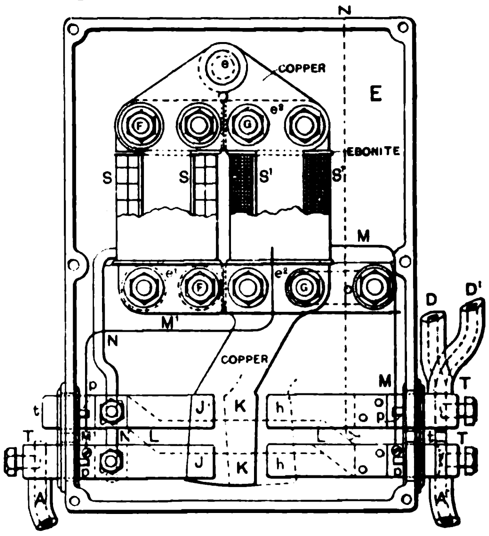

FIG. 9.

(1) It will save largely the costs of installing, as it will in all cases permit the use of the copper in the mains to its fullest carrying capacity over very extended areas, for although subdivided and possessing, therefore, all the advantages of duplication, the aggregate of such mains as to sectional area of copper will not exceed that of a single pair. (2) It will reduce loss in transmission in the mains to a minimum and prevent variation of pressure due to varying load without regulation on the circuits, while additions to the number of primary mains can be made from time to time, thus increasing its aggregate section and increasing thereby the capacity of the low-tension distributing mains without increasing their section by the interposition of additional converters at suitable points fed by such additional primary mains. (3) It will save cost of working, as only sufficient converters and dynamos actually required to do the work on the circuits need be in action, thus avoiding the consumption of energy by friction and useless magnetizing current. (4) It will permit the regulation and control of the whole system from the central station, and the act of breaking or making any primary circuit will disconnect or connect the secondary windings of the converters thereon from the general low-tension supply system without interrupting the supply to any consumer. (5) It will ensure in case of any dynamo or transformer breaking down that the

faulty machine is automatically cut out and not the sound machine as at present when two or more are working in parallel, and also automatically replace it if the fault is only temporary and removed. (6) It will prevent any dynamo or transformer being reversed or fed by the others when working in parallel should its E. M. F. fail from any cause. The automatic controller will act as a non-return valve, and will cut out any machine not doing its duty, and restore it if the cause is only temporary and removed. (7) It will not consume energy in the automatic control switches when the machines are either in or out of action. (8) It will be absolutely reliable, as the automatic switch may be made to any power desired, as the energy is only used at the moment of making or breaking. (9) It will not rely on an instantaneous rush of current, as the power in the control switch will remain in action until the duty of the switch has been performed, then will instantly cease. (10) It will entirely remove serious risks from the accidental earthing of any two mains of opposite polarity when two or more pairs are working in parallel from common omnibus bars or through transformers—the most faulty will be automatically cut out, and if necessary be immediately reinstated by a cross switch making the faulty mains of same sign, the exciting circuits of alternators breaking down, or accident to any part of any machine interfering with the constant supply to consumers. (11) It will permit repairs, additions, testing, etc., to be done at any time without danger to the operatives or interference with the constant supply to any consumer, as any section of the subdivided main may be cut out of action for any such purpose without the remainder being affected thereby. (12) It will not require any disturbance of the roads when once the culverts are installed, as by this method of subdivision all the mains, both of high and low tension, even for very dense districts, will be of small section, flexible, and therefore easily handled, drawn-in, added to up to the capacity of the culverts, and all joints made from the surface. (13) It is easily applied to existing systems, and will greatly increase their capacity, safety, reliability of supply, and decrease their cost of working.

If, therefore, due consideration be given to the above advantages, and the fact be recognized that the loss in mains or any parallel circuit must, for the sake of the regulation of the pressure, be only a small percentage of the total E. M. F. of the circuits, the unsuitability of the low-tension as compared with the compound intraposed automatic system for distributing electricity over even moderately large areas will be at once apparent, and in this relation the following law should be strictly borne in mind—viz., that in an electrical circuit distributing equally along its length, the loss in the mains is as the square of length; or, the mains must be increased in like proportion, when the carrying capacity of the copper could only be utilized inversely as the square.

The writer of the foregoing in comparing the value to be attached to the system described, had recourse to the Board of Trade returns for 1893, and the annexed is a summary of a *pro forma* balance-sheet of average of twenty-nine central stations which will be interesting:

Electricity Supply Only (High, Extra High and Low Tensions), Twenty-nine Stations' Averages.

Cr. (1893.)		
15,500,000 units at 5·9		
Average price received		£381,000
Average price cost	5·90	
Average price margin P. and D.	3·78	
	2 12	
Per cent. cost to revenue		
Per cent. cost to capital	64·55	
Per cent. revenue to capital	5·49	
Per cent. on capital for redemption	8·50	
Per cent. on capital for deficit	3·33	
Units to the £ capital	0·32	
	1·00	

Dr. Costs.	
Per cent. to capital.	
2·58 costs low tension	£116,000
2·17 costs high tension	96,450
0·74 costs extra high tension	33,540
5 49	£245,990
Say	£246,000
3·33 redemption fund at 3.33 per cent	149,400
8·82 on £4,482,000	£395,400
·32 deficit.	
8·50 ·32 per cent. deficit	14,400
	£381,000

If redemption fund is reduced to 3 per cent. accounts will balance without deficit.

THE DEVELOPMENT OF THE ELECTRIC TELEGRAPH.—VIII.

BY STEPHEN VAIL.

The Government did not become the owners of the patent for the telegraph, and "The Magnetic Telegraph Company" was organized to erect a line from Philadelphia to New York, its construction being begun in the fall of 1845, and on January 4, 1846, Mr. Vail wrote from the former city to Mrs. Vail, then in New York: "I have been very busy since I arrived here, putting up the instruments and getting the necessary things for the office. On January 1st we made the first trial of the wires between here and Norristown—eighteen miles—and all went off very well. I have had the lines in operation every day since, but not open to the public, as I dislike to have persons running to the office when I am testing the wires and not prepared to do business. In a few days I shall remove the instruments from Norristown to Doylestown, and then further on the route to New York."

On January 18th he wrote: "We have tested the line almost through, and the other end is now at Newark, nine miles from New York. To-morrow I expect to communicate to Newark, and hope soon after to test to New York. Our operations produce great excitement and my room is crowded from morning to night." On the 24th of January he wrote: "The telegraph is going ahead and must go! It cannot stop now! The line is in *operation* between this and Newark!"

Upon reaching the city of Newark, N. J., it was determined to seek business between New York and Philadelphia, and a notice to that effect was issued to the public as follows:

"New York, Jan. 26, 1846.

"SIR: The Magnetic Telegraph between New York and Philadelphia, via Newark, will be opened to the public on Tuesday, January 27th. Messages will be dispatched from the telegraph office, No. 10 Wall street (basement), New York, at 9 and 11 A. M. and 12 o'clock M., 3, 4 and 7 P. M., and will be received from Philadelphia, via Newark, at 8½, 9½ and 11½ A. M., and 2½, 4½ and 10 P. M. Communications, which must all be prepaid, will be sent in the order in which they are received.

"The following are the rates established for ten words and under: For the transmission and writing out of every communication not exceeding ten words, exclusive of the signature and address and the directions of the writer as to the disposition of the communication, from New York to Philadelphia, twenty-five cents. For every addition, not exceeding ten words, the same rate of charge as in the first ten. Yours truly, AMOS KENDALL, President."

The line was completed as far as Fort Lee, on the Jersey shore of the Hudson River, opposite the upper part of Manhattan Island, on January 20, 1846, but there the river presented an obstacle that for some time was not overcome, no method of insulation in water having then been discovered. On the New York side of the river was the residence of Audubon, and his consent being obtained for the establishment of an office on his premises, messages were brought from Fort Lee, across the river, by boat and sent to the Wall street office by wire.

Those who may have read citations I have made will have no difficulty in noting but one object, viz., to show just exactly what part in the invention of the telegraph each and every one connected with it should be credited for, nothing more and nothing less, and absolutely free from any wish or intention to deprive any of his just dues or to add one iota to the actual credit belonging to each one. If I have done actual injustice to any one, I shall be only too glad to make the *amende honorable* upon being shown my indiscretion.

Prof. Wm. B. Taylor, before referred to, has written: "With that strong 'subjectivity' (perhaps essential to the success of both the artist and the artisan) which characterized him, Prof. Morse always believed his invention to have been practically full-fledged at its birth, or rather at its conception, and, quite unconscious of the slow and small advances derived from gathered experience or external suggestion, failed seemingly to realize how completely his earlier methods were discarded and displaced by later improvements."

Alfred Vail passed from earth on the 18th day of January, 1859, not yet fifty-two years of age, and at the meeting of the Directors of the American Telegraph Company in Philadelphia to take appropriate action upon the loss of one of their number, many expressions of sorrow, sympathy and honor were made. Mr. B. B. French said: "To him, Alfred Vail, the telegraph interests of America owe much, and it is the duty of all engaged in this now immense and vastly important enterprise to pay to his memory a tribute of respect. For honesty of purpose, industry and perseverance in whatever he undertook, Mr. Vail was surpassed by no one, and in mechanical ingenuity by few."

The Hon. Amos Kendall, ex-Postmaster General, in seconding the resolution said: "Mr. Vail was one of the most honest and most scrupulously conscientious men with whom it has ever been my fortune to be associated. To him was Prof. Morse indebted, not only for means and assistance, but for valuable suggestions in bringing his telegraph to perfection, and, *if justice be done, the name of Alfred Vail will forever stand associated with that of S. F. B. Morse* in the history of the invention and introduction into public use of the electro-magnetic telegraph."

The above are the opinions of his associates as to the integrity and skill of Alfred Vail, for whom is claimed the real invention of the telegraph, and it is quite certain that they knew more than they deemed it prudent to say as to this claim, for Prof. Morse was one of them.

An anonymous lover of justice has thus written: "The name of Morse has been honored and become famous in every land. Decorations and honors were showered upon him by kings and potentates. His grateful countrymen held him in veneration and erected a bronze statue in his honor in Central Park, New York, while he was yet living." [A very general impression existed at the time that this was the work of the Western Union Telegraph Company.] "This was right and proper. But it was not right and proper for the modest, unassuming inventor of Morristown, whose inventive genius and mechanical skill produced the instrument that sent the message, the instrument that received it and the alphabet in which it was sent, to be ignored and left in obscurity.

"Justice is sometimes tardy, but the facts in this case are becoming known, and the time is not far distant when full justice will be done the memory of Alfred Vail. Monuments and statues are going up all over the land to heroes, poets, inventors and great leaders in all walks of life. Some day a great national monument will rise on which the name of Alfred Vail will stand side by side with that of Morse, honored, equal and imperishable."

STEPHEN VAIL.

Motive Power Required for an Electric Railway.

To make an exact calculation of the motive power required to operate an electric railway, says the *American Engineer and Railroad Journal*, the first step to be taken is to settle upon the frequency with which cars are to start from the two ends of the line, as well as the maximum and average speeds to be maintained. When this is laid down graphically the number of cars in service can be readily deducted. The calculation of the motive power required for each car for the round trip is based upon the estimate of 20 lbs. per ton for resistances upon a level track, and 10 lbs. per ton for each 1 per cent. of gradient, and finally by adjusting the power required so as to adapt it to the speeds of the car upon the grades and level stretches. If then we apply the formula that is applicable to the different points along the line, it will be easy to construct a polygon whose area will be enclosed between lines that represent the amount of work required to keep the cars in motion. By referring this to the graphical representation of the running cars it is possible to determine the amount of power required by each car at each instant, as well as the total power required by the whole number of cars at the same instant. If the matter is carefully done these calculations should be made at one-minute intervals for a round trip. In this way we will find the maximum, the mean and the minimum power required, it being possible that the last may be zero. The figures thus obtained only indicate the power which must be applied horizontally to the axles of the cars. In order to obtain the power which will be required at the station we must take the efficiency of the different portions of the system into account, and this may be rated as follows: Motors and gearing, 70 per cent.; line, 90 per cent.; generating dynamo, 90 per cent.; steam-engine and belting, 85 per cent.; giving an average efficiency of 48.2 per cent. We may, therefore, consider that we utilize about 50 per cent. of the H. P. indicated at the cylinder of the engine.

Practically these calculations are very quickly made, because experience has shown that a certain number of kilowatts will be required for a given number of cars, and that almost entirely independent of the profile. The following figures may be taken as typical:

Generating dynamo, 60 kilowatts, 4 cars.
" " 100 " 6-7 "

It may be readily understood why this should be the case, because when there are up grades in one direction they become down grades on the return trip, and the car will require no current while running over them. The calculations will be very nearly exact, for no account is taken of the times when the current is shut off. It is admitted, too, that it takes as much current to bring a car from a standstill up to speed as it does to ascend a 3 per cent. grade at a speed of 7½ miles per hour. In any case the figures obtained by this method of calculation are valuable, because they show the great variations in power that may occur, and that the regulation of the steam-engine should be very sensitive in order to meet the sudden variations in load to which it is subjected. In fact, it is not an uncommon thing in the central stations of electric tramways to have the needle of the ampere meter vary suddenly one way or the other by as much as 150 amperes. It is, therefore, desirable to know the relationship that exists between the maximum and the mean motive power. If this ratio rises above two, as occurs in lines running only four or five cars, the best steam-engine to use is one of the high-speed type having a very heavy fly-wheel. The advantage of using a high-speed rather than a low-speed engine for such work as this is, of course, apparent to any one who will think about it. For however sensitive the valve regulation may be in fixing the point of cut-off, it acts upon the admission valve and can only make its influence felt near the beginning and end of the stroke; hence it is certainly more rapid in an engine making 250 revolutions per minute than in one making 60.

When the ratio of maximum to average power is included between 1½ and 2, as when from six to eight cars are run, a slower engine can be used if it is provided with a very heavy fly-wheel. Above eight cars, the best engine to use is one of the Corliss type, for the suddenness of the variation from maximum to minimum is greatly reduced.

These opinions have recently been confirmed by a visit to a central station of an electric railway, where a dynamo of fifty kilowatts nominal power at 600 revolutions is driven by a steam-engine running 120 revolutions per minute. The fly-wheel of the engine is very small, both in diameter and weight; under these conditions it is easy to detect a variation of 50 per cent. in the speed of the engine, which occurs at regular intervals corresponding to the stopping and starting of the cars; yet the stops being fixed, and none being made on signal, the variations in the work to be done are not as great as would occur under other conditions.

The power for running the Lyons-Oullins Railway in France was recently calculated in this way, as reported in *L'Electricien*, and it was found that from 120 to 160 H. P. would be required at the central station in order to operate from six to eight cars. Under these conditions an engine of 150 H. P. was required, with a capability of rising to 200 H. P. for short intervals in case of necessity.

A German contemporary gives some interesting particulars respecting a new projector system, which it is intended to experiment with in connection with the next German military and naval manœuvres. For field purposes the installation comprises an 18 horse-power portable engine, to which are attached a dynamo and an electric projector. The special point is that the light is not thrown direct upon the enemy, but on to a mirror situated about 200 meters away from the plant, the object being to deceive the enemy as to the position of the plant, and thereby cause them to direct their fire to a wrong situation. To the mirror is attached an electric motor connected by cable with the dynamo, so that those running the installation can shift the angle of the mirror as required. This plant will be used in the beleaguring of Thorn. It is also to be used in harbor defence against a marine attack.

A Bolometric Study of Light Standards.

BY CLAYTON H. SHARP AND W. R. TURNBULL.

(Concluded from page 40.)

The Hefner light is a much more promising standard than the candles, although its curves show that it is subject to incessant fluctuations and that considerable variations may last for a minute or more. It is clear, however, that from a series of observations, extending over a comparatively short time, a very good average may be expected.

The highest point on the Hefner curves is 1.093 of the mean, and the lowest is 0.867, giving a total deviation of 22.6 per cent. This large deviation is not so significant, however, as a similar one in the case of candles, since in dealing with the Hefner lamp we have to do with an adjustable flame, and these fluctuations may indicate only that a slight readjustment was needed.

The most important question in regard to the Hefner lamp is the accuracy with which it can be adjusted to its normal light intensity. Some idea may be formed of this by noting the percentage deviations of the first five minutes of each of the curves from the mean ordinate of the first five minutes of all the curves. The maximum deviation will be seen to be 8 per cent., while the mean deviation is 2.3 per cent.

If, now, the assumption be made that the light-giving efficiencies of the English and German candles and of the Hefner lamp are equal, it is possible to get their relative intensities by a comparison of the mean ordinates of their curves. Reducing the deflections as read on the telescope scale to angular measure and taking double the tangents of these angles, we have for the true deflections the following values:

English candle = 41.06
German candle = 50.40
Hefner light = 38.66

From these values we get the following ratios:

$$\frac{\text{German candle}}{\text{English candle}} = 1\ 2275$$

$$\frac{\text{Hefner light}}{\text{English candle}} = 0.9415$$

Violle's values for these ratios are 1.18 and 0.98 respectively.

In the curves given by the Carcel lamp the deviations were, for the most part, no larger than the swings of the galvanometer when the bolometer was unexposed to radiation. The variations extending over a considerable period of time are, however, by no means inconsequential. In one curve there was a total deviation in the mean ordinates of the five-minute periods of 5.1 per cent., taking place in ten minutes. Another curve shows a deviation of less than 0.8 per cent. in thirty-five minutes, and this is perhaps a more typical illustration of what may be expected from this lamp when burned under the best conditions. The highest and lowest points on any of the Carcel curves are 29.9 and 25.4 respectively, corresponding to deviations from the mean of the curves of + 5.7 per cent. and — 12.5 per cent., or a total of 18 2 per cent. A table is given showing the maximum deviations, for periods of five minutes, to be + 5.3 per cent. and — 8.4, giving a total of 13.7 per cent.

The mechanical parts of the lamp used were in good working order. Pure Colza oil was used for burning, and rates of combustion were determined by weighings made before and after the runs. The regulation wicks were employed, a fresh one being used for each run.

The Argand burner connected directly to the gas-pipes in the building. The pressure of the gas was controlled only by a large regulator on the main pipe leading into the building. The consumption of gas in the building was constant during the run. The curve shows many large, but quick, variations and certain decided waves. The other Methven curves were taken with a gasholder of about ten gallons' capacity interposed between the gas main and the Argand burner. The effect of this in smoothing the curves is very marked, and indicates that for photometric purposes the Methven screen is much improved by the interposition of a rather capacious reservoir. The use of such a reservoir tends to minimize the effect of changes of pressure and to absorb any waves in the gas due to water in the pipes or some similar cause.

The way in which these waves of variable pressure produce fluctuations in the amount of radiation is by causing changes in the quality of those portions of the flame which cover the slit. At times the top of the flame becomes forked, so that not all of the slit is covered by it. It happens perhaps more frequently that some of the non-luminous portion of the flame rises so as partially to cover the slit. In either case the result is seen in a deviation of the curve. It must be true, also, that the amount of luminous radiation suffers a much larger proportional change than the total amount of radiation; hence the deviations recorded on the curves are too small to represent correctly the fluctuations in luminous intensity. There is an additional reason for these fluctuations, which is to be found in the slight protection against draughts of air which the wide open chimney used on the London Argand burner affords. In this respect its action is in marked contrast with that of the smaller close chimney of the Carcel lamp, which, of course, can be used only with much richer gases than ordinary illuminating gas.

These Methven screen curves cannot be trusted to give a true idea of the reproducibility of the standard. This is because the ordinates of the curve represent not only the radiation from the flame, but also that from the chimney and from the screens interposed. Since the burner was not always replaced in exactly similar positions before the bolometer, the amount of this radiation was variable. A more serious source of error, however, arose from the fact that after several of the curves had been taken it was found advisable to change the original arrangements for screening. The plan finally followed was to interpose between the Methven screen and the bolometer-box a heavy piece of asbestos paper, having a hole of proper size cut in it. This was placed so far from the burner that it did not become heated perceptibly.

The difficulty arising from the intermingling with the radiation from the flame of a variable amount of non-luminous radiation from chimney and screens could have been entirely obviated by determining, in a way which did not suggest itself until after most of the runs had been taken, the effect of this variable radiation. After the burner had been lighted long enough for the chimney and screens to become heated to their ultimate temperature, the flame was suddenly extinguished and the screen covering the bolometer strip was raised. Then a curve of cooling of the hot chimney and screens was plotted, using times as abscissas and deflections as ordinates. This curve, carried back to the time of extinguishing the light, gave the amount of radiation received from all parts except the flame. The importance of this correction was not fully appreciated until the results of observations were worked over, after all the runs had been taken; consequently the method was not developed very completely. The records show that in the case of the Carcel lamp the amount of radiation from the chimney varied slightly.

At the sixty-fourth annual meeting of the British Association, now in session at Oxford, a brief report of which appears elsewhere in this issue, there were nearly 2,500 people in attendance.

Polyphase Work.

It has been a matter of comment among foreign engineers that so little has been done in this branch of electrical engineering in Great Britain.

In America, and on the Continent of Europe, polyphase motors and systems of transmisson of electrical energy to a distance have interested and engaged the closest attention of the foremost electrical engineers; and the subject has rapidly assumed a most important commercial position, as well as a highly scientific development, so that polyphase principles are likely to largely influence the future lines along which electrical engineering progress is to run.

At the outset the alternating current system commenced with transformers in each consumer's house; the energy was transmitted from a centre to these transformers at high pressure, and from the transformers the energy was distributed at low pressure throughout the house. Now, however, the practice is to lay down two sets of mains, one a high pressure transmission set, carrying the energy from the central station to sub-stations where it is transformed, while the other set of distribution mains distribute the energy at low pressure within a certain distance from the sub-station.

The primary mains are for transmission, the secondary mains for distribution. There is not, we are afraid, sufficient importance attached to the difference between the two. Transmission lines must be worked at high pressure, and by a current easily and efficiently transformed. Distribution lines must be worked at low pressure by current derived from the transmission current or primary feeders.

Now the primary high pressure current sent along the transmission feeders to the sub-stations may be, and in this country always is, a single-phase alternating current, and this can be easily and efficiently transformed to a single-phase low pressure current only. It cannot easily or efficiently be transformed into a polyphase or a continuous current, and this is where polyphase principles come in in the electrical transmission and distribution of energy in towns.

If we adopt polyphase currents for the transmission of the energy, we find that at the sub-stations we can, with ease and high efficiency, convert it into low pressure continuous current, low pressure single-phase alternating current, or low pressure polyphase currents to supply the distribution mains, and thus we have a choice of any of the three currents for distribution, and may supply any one, or all three, from any sub-station.*

It may truly be said that in the present state of electrical engineering only a supply for lighting is in demand, and that, for this purpose, low pressure single-phase current meets the demand entirely. Quite so ; but if with equal economy and the same plant, and no additional trouble, we can transmit our energy by polyphase currents and thereby secure the advantages of being able to supply any other kind of current from the sub-stations, why should not polyphase transmission in every case be adopted, especially by municipal bodies, who must look forward to the continual extension of their electric systems?

It is all very well for a company with a district limited in area allotted to them for lighting to lay down a system of three-wire low pressure mains, or a system of single-phase transmission mains and a few sub-stations, but for a public body to do likewise is doubtful policy; they must look to the future, and adopt the system which offers them the greatest facility in obtaining, from a transmission current of high pressure, the various forms of electric current used in practice. The only transmission currents for such purposes are polyphase.

On these grounds the two-phase method was adopted for the transmission of the energy from Niagara Falls. With this it is possible to supply distribution systems with either or all of the other kinds of current from sub-stations, and for the same reasons the transmission of electrical energy throughout towns ought to be carried out by polyphase currents. The distribution may be effected, then, by single-phase, polyphase, or continuous current, just as we please.

It has already been pointed out in the *Electrical Review* that polyphase currents are preferable for electrical installations in mines and on board steamships, if for no other reason than the one that commutatorless electromotors may be applied to do the work of steam and hydraulic engines now used in these places.

Polyphase motors alone fulfil the requirements in a mining motor; there can be no sparking; it requires absolutely no attention except lubrication, and it can be started, stopped or reversed by a switch at a distance. The polyphase currents can be transmitted at high pressure and transformed either for lighting or power purposes anywhere in or about a mine.

On board steamships many small, wasteful, troublesome steam engines are now used for various purposes, such as ventilating, pumping, refrigerating, operating winches, ash hoists, etc. All of these could, with ease and with profit, be replaced by electromotors without brushes and commutators. All that is necessary is to distribute the electrical energy in two-phase currents; light and power may then be obtained anywhere on the ship with equal ease.

If the electromotor had not hitherto had a commutator and brushes continually requiring attention, it is quite probable that it would have been adopted to a much greater extent in mining and marine operations.

It has been hinted that the fear of litigation on the patents question has deterred engineers from recommending the polyphase system and the polyphase motor. This is a reflection on our engineers; it implies that they would adopt them freely if they could do so free of cost, and that they would rather stay their introduction than pay royalties.

Whatever is the cause of the apathy displayed towards new developments in this country, we do not know; it is a curious fact, however, that a long time elapses between the introduction of really good inventions and their adoption. This is the case with polyphase work; its advocates are enthusiastic and make great claims for it, have spent time, money and brains in perfecting it, and yet the ordinary engineer jogs along the beaten path quite oblivious to all their efforts. Another case in point was that of the transformer; for years up till 1886 it was advocated by enthusiastic inventors, only to meet with scorn or pitying smiles.

We believe there is a good deal of truth in the claims of polyphase advocates, and that they form a subject worthy of close study by every engineer. Like all really beneficial inventions, it promises to widen the field of usefulness and application of electrical science and appliances generally.

The polyphase motor has received only small attention here, and that by only two or three engineers. In inquiring into the nature of these motors, it may be as well to point out that there are two distinct classes—rotary current motors, on the Ferraris-Tesla system with rotating poles, and induction motors with no rotary poles, on the Kennedy and Stanley system. In looking up the patents question on polyphase motors, it is well to distinguish carefully between the two types. In a series of articles shortly to appear in our columns, a simple explanation of the fundamental actions of these induction and rotary polar motors will be attempted, with a view to distinguish between the different types, and to place a simple conception of their construction and action before the student.

A commutatorless single-phase motor has been fully developed by the Oerlikon people, but we believe it requires a commutating device to start it. We are not aware of any tests made with it in this country, but if any are available it would be interesting to compare them with tests of polyphase motors.

The single-phase induction motors have one advantage over synchronous motors in that they are much easier started, not requiring to be run up to synchronism. All they demand is a start up to about one-fourth of the normal speed.—*The Electrical Review* (*London*).

Recollections of Werner Von Siemens.*

XII.—Scientific Writings.

Under the title "Contributions to the theory of electro-magnetism" I communicated two dissertations to the Berlin Academy in the years 1881 and 1884, in which the theory of magnetism was considerably extended, and parts of it, that had hitherto remained obscure, were cleared up. I arrived thereat by experiments with tubular electro-magnets, which gave the looked-for result that iron exerts no, or at any rate no appreciable, protection against magnetic action at a distance, and that the magnetic maximum of iron is independent of the direction of the magnetism. From this it follows that the magnetism called forth in iron by a magnetizing force is diminished by a simultaneous magnetization in another direction. The maximum magnetization occurring in ring-magnets even with feeble magnetizing power shows that the strengthening magnetizing effect which magnetized iron molecules exert on their neighbors considerably outweighs direct magnetization. This led me to the modification—already previously adopted by Stefan, as I afterwards found—of Weber's electro-magnetic theory, according to which the assumed elementary solenoids must be double solenoids, which as such move about freely in space, and are directed by a magnetizing force acting upon them, and then rotate round one another in a scissor-like fashion. If we suppose the whole universe to be filled with such double solenoids, which after the theory of Father Secchi and Edlund might be conceived as ether-vortices, and that iron and the other magnetic bodies were distinguished from the non-magnetic by the ether-vortices pre existing in a unit of volume being more numerous in the former than the latter and in empty space, magnetic action at a distance might also be regarded, according to Faraday's suggestion, as an action proceeding from molecule to molecule or from space-element to space-element, and we should then be warranted in applying the laws for the molecular transference of heat, electricity, and electrostatic distribution to magnetism also.

This theory on its side compels us to assume that magnetism, like the electric current and electric distribution, can only exist in closed circuits, in which the magnetic "moment" is inversely proportional to the resistance of the circuit. This consideration leads therefore to the introduction of the notions "resistance to magnetic distribution" and "magnetic conductivity" of space and magnetic bodies. According to this, only so much magnetism can be produced in an iron rod by an electric current circling round it as can be conveyed from one to the other pole, or absorbed by the space surrounding the iron rod. My experiments have confirmed this view, and their result shows that the magnetic conductivity of soft iron is approximately 500 times as great as that of non-magnetic matter and empty space.

Accordingly in the construction of electro-magnetic machines Ohm's law may be applied for ascertaining the most suitable dimensions, which will in many cases be useful to the electrical engineer. The notion first introduced by me, so far as I know, of magnetic conductivity has meanwhile often been employed and further developed in technical works without any reference however to my priority.

The attempt described in my work on the sun's potential, to refer certain meteorological phenomena to disturbance of the indifferent equilibrium of the atmosphere, had convinced me that in meteorology the requirements of mechanical equilibrium and the principle of the conservation of energy had not hitherto received proper attention. Recent meteorology, in its endeavor to deduce all the phenomena of atmospheric motion from its extensive material of observation, has too much lost sight of the causes of these movements. Scientists were generally content to be able to refer the aerial movements to the observed maxima and minima of the pressure of the air and its movements, and were satisfied with pointing to local influences of temperature and the earth's rotation in explanation of the causes of these maxima and minima. In my paper "On the conservation of energy in the earth's aerial ocean" I have set up and defended the principle that every motion of the air is *exclusively* to be ascribed to the unequal heating of the air by the sun's rays, and that the earth's rotation can produce no new motion of the air, but only change the direction of the motion produced by solar influence. One direct consequence of this principle is, that the sum of the *vis viva* stored up in the rotation of the aerial ocean on the earth's axis must unalterably be that which this ocean would have if no meridianal motion of air were produced by solar influence, and the air everywhere had the rotary velocity of that part of the surface on which it rests. In consequence of the accelerating equatorial ascent of the overheated air, streaming to the equator in the trade-winds, a back current takes place in the upper regions of the atmosphere towards the poles, which, however, only in a small part can reach polar latitudes. The reason of this is that, owing to the narrowing of the upper and simultaneous expanding of the lower stratum—in consequence of the decrease of the latitudinal circles on approaching the poles—a partial passage of the upper poleward moving current must continually take place into the lower current towards the equator. It is the inertia of the upward poleward traveling current which carries back the air in the lower one to the equator. By this circulating current, continued for untold thousands of years, the air of the higher latitudes is intimately mixed with that of the lower ones, and the whole aerial ocean must therefore rotate with the mean easterly velocity of the earth's surface. The westerly course of the trade winds is thereby explained, as well as the mean easterly direction of the aerial currents in the intermediate and polar latitudes. The maxima and minima are essentially concomitant phenomena of the alternation of temperature and of the velocity of motion of the upper equatorial air current, and always depend on disturbances of the indifferent equilibrium of the overlying air-strata. When an aerial current, which has a higher or lower temperature than corresponds to its altitude in the adiabatic curve of temperature, breaks into the highest regions of the aerial ocean, the indifferent equilibrium of the whole aerial column is thereby disturbed, and neutralization must take place by ascending or descending motion of air, according as the invading higher currents of air are too warm or too cold, thus also too light or too heavy for the indifferent equilibrium. This ascending or descending aerial motion must last until the indifferent equilibrium of the column of air is again restored, and the consequence then is that the pressure of the atmosphere at the surface of the earth becomes as great as it would be if the temperature of the whole column of air had changed as much as the equatorial current, causing the disturbance, deviates from the adiabatic temperature corresponding to its place and its height. As the consumption of heat during the active expansion of a quantity of air is independent of its commencing temperature, the air ascending at different places in the torrid zone must retain the differences of temperature which it possessed before the rise. Hence it follows that relatively warm and cold currents of air flow polewards with different velocity in the higher and highest strata of air, and thereby disturb the indifferent equilibrium of the atmosphere in its whole course. Slowly flowing, too cold currents will give off their surplus pressure to the lower aerial strata on which they are resting, without causing important disturbances by compressing them and thereby causing a rising barometric pressure in a calm atmosphere. Air-currents, which are relatively light, hot, and therefore strongly accelerated during their ascent, will on the other hand cause to undulate and carry with them the surface, insufficiently weighted by them, of the aerial strata over which they pass, and will thus, with a falling barometer, cause upward aerial movements, lasting until the indifferent equilibrium is again restored in the whole column of air. According to this, variations of temperature of 20 to 40° F. in the highest strata of air suffice to produce the barometric fluctuations observed at the earth's surface, thus also the maxima and minima of the atmospheric pressure.

This theory has met with considerable approval; it, however, received the assent of the adherents of the prevailing views only in certain points, or is even entirely ignored by them. I have had occasion repeatedly to defend and further develop it. The papers relating thereto are entitled "On the question of air currents" (1887), "On the general system of terrestrial winds" (1890), and "On the question of the causes of atmospheric currents" (1891). I am convinced that my theory will gradually meet with universal acceptance, as it rests on a basis of facts. It is a necessary consequence of our system of instruction, however, that new fundamental views, which contradict previous doctrines, should only slowly gain ascendency. They must first be embodied in text books, and that can only take place when the new theory is worked out on all sides and the ruins of the hitherto dominant ones are cleared away.

(*Concluded.*)

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[*] Selected from "Personal Recollections of Werner Von Siemens," recently published in America by D. Appleton & Company, New York, 416 pp., 12mo, uncut edges, wide margin, photogravure portrait.

Base Ball—Western Electric vs. Chicago University.

The Western Electric Base Ball Club, of the Western Electric Company, having won nearly every game played with commercial teams in Chicago, has determined to try conclusions with Prof. Stagg's crack University team. The game is to be played on the grounds of the University, Saturday afternoon, August 25. The names and positions of the players are as follows:

Western Electrics.		Chicago University.
Kerns	Pitcher	Stagg.
Stock	Catcher	Pike.
Kelley	1 Base	Winston.
Meehan	2 Base	Adkinson.
Lyon	3 Base	Rothschild.
Parker	Short Stop	Nichols.
Hanrahoe	Left Field	Brown.
S[illegible]all	Centre Field	Bowers.
McKevitt	Right Field	Spear.

BOOK REVIEWS.

ALTERNATING CURRENT WIRING AND DISTRIBUTION. By WILLIAM LE ROY EMMET, E.E. 8vo., pp. 76. New York: "The Electrical Engineer." Price, $1.00.

For many years we have had excellent wiring tables and other short-cuts to assist the engineer and artisan in figuring out a wiring scheme where Ohm's law was the basic principle. For some time after the first introduction of alternating currents it was known to but a comparative few that these same tables and short-cuts were not applicable to alternating currents. Gradually, as experience was gained, it was observed that the copper that was sufficient for direct currents was inadequate to alternating currents, but just what allowance should be made for the latter over and above that required by the former was not for some time known and empiricism became the rule. Gradually, as the effects of self and mutual induction and capacity of lines became better understood, empiricism gave way to more logical and accurate methods, and to-day there are numerous large works that deal with the subject of alternating current wiring and distribution in a most thorough manner. Works of this character are apt to be too technical for the average reader, and on account of their expense often beyond his reach. The present work is an attempt to obviate both of these difficulties, and is a welcome addition to the rapidly growing literature of alternating currents.

HOW TO BUILD DYNAMO-ELECTRIC MACHINERY. By EDWARD TREVERT, Lynn, Mass. Illustrated. 8vo., pp. 330. Bubier Publishing Company. Price, $2.50.

This is an elementary work intended for amateurs or those who aspire to the making with their own hands machines of the character described. There is something very fascinating in works of this kind, and while there are a number of books already on the market intended to cover exactly the same ground as this, Mr. Trevert's book is by far the fullest that has come into our hands. The scope of the book is indicated by its table of contents, which we herewith reproduce: Chapter 1, Historical Notes; 2, Principles of Dynamo-Electric Machines; 3, Methods of Field Magnet Winding; 4, Forms of Field Magnets; 5, Armatures; 6, How to Make a Toy Electric Motor; 7, How to Make a Small Dynamo; 8, How to Build a Two-Light Dynamo; 9, How to Build a One-Half Horse Power Motor or Dynamo; 10, How to Build a One Horse Motor or Dynamo; 11, How to Build a Twenty-Light Dynamo; 12, How to Build an Alternating Current Dynamo or Motor; 13, Types of Commercial Dynamos (direct current); 14, Types of Commercial Dynamos (alternating current); 15, Types of Commercial Stationary Motors; 16, Types of Commercial Railway Motors; 17, Management of Dynamos and Motors. Appendix A, Tables of Wire Gauges; B, Some Practical Directions for Armature Winding; C, Some Practical Directions for Field Magnet Winding.

The illustrations are full and fairly executed, many of them [illegible] working drawings from which patte[illegible] for castings may be made, and the exp[illegible]ions are explicit.

The [illegible]ok is readable, instructive, and should find a wide field of usefulness.

For the lighting of Antwerp the novel plan is proposed of distributing water from steam pumping stations at a pressure of 775 pounds per square inch and using it at small district stations for driving dynamos by means of turbines. These stations would supply local consum[illegible] through a low-pressure two-wire circuit s[illegible]. The cost of coal per 16-candle power an[illegible] is placed at only 2½ cents.

FOREIGN NOTES.

The German Finance Minister has arranged for the establishment next year of chairs of Electro-Chemistry at the technical High Schools of Berlin, Hanover, and Aix la Chapelle.

Messrs. Ducretet & Le Jeune, of Paris, have placed on the market a novel portable testing set. The case which contains the instruments is fitted with a galvanometer having shunts $\frac{1}{2}$, $\frac{1}{10}$, $\frac{1}{50}$, $\frac{1}{100}$, and $\frac{1}{1000}$ multiplying values, and a plug-commutator which couples the galvanometer either to a fixed standard resistance of 10,000 ohms contained in the apparatus or to the cable to be tested. A second case contains eighty cells, dry battery, coupled in series, giving a difference of potential of about 100 volts. The galvanometer needle is composed of a magnetized bar, fixed to a thick copper disk, slightly recessed to receive it. The current traverses two flat coils of rectangular section secured on either side of the needle with clearance space. The needle oscillates in the interior of the coils. Fixed parallel to the magnetic needle is an index or pointer of aluminium. In making insulation tests two readings are taken, one of the deflection when the 10.000 ohm coil is plugged in circuit, and the second with the cable whose insulation is to be measured.

Herr Schultz, a German authority, holds that shunt dynamos cannot be made for over 1,000 volts, and series dynamos for not over 3,000 volts. For simple transmission with 6,000 volts, for instance, as distinguished from distribution together with transmission, he suggests using two series-wound dynamos connected in series, each of 3,000 volts, to connect these over the line wires with two series wound motors similarly connected; it is essential that the motors be coupled mechanically, otherwise they will not be equally loaded and would require regulators.

General News.

What is Going on in the Electrical World.

Warren, O.—The Mineral Ridge and Niles Electric Railroad has been sold under an order of court for $27,800.

Peoria, Ill.—The Pekin and Peoria Electric Street Railway Company have been granted a twenty year franchise for their proposed railway line.

Alpena, Mich.—A fire on the 13th inst. destroyed the electric plant of the Northern Electric Works, manufacturers of tannic acid from hemlock bark.

Rochester, N. Y.—The lease of the Rochester and Charlotte Railway by the Rochester Railway Company for a term of fifty years has been agreed upon.

Cincinnati.—The city council has decided to adopt the ten-year contract plan for electric lighting, and will advertise for bids. The existing contract for electric lights expires November 1.

Jacksonville, Fla.—The council has passed to the second reading an ordinance providing for the purchase and erection of an electric lighting plant by the city at a cost not to exceed $75,000.

Buffalo, N.Y.—The new trolley line between Tonawanda and Buffalo, via Kenmore, has been opened for traffic. There are now three electric railway lines between Buffalo and the Tonawandas.

Jackson, Tenn.—The city has declared the contract forfeited with Shipman & Co., of Washington, for lighting the city by electricity. Advertisements are to be made again for new bidders.

Stroudsburg, Pa.—Erastus Wyman arrived at the Delaware Water Gap for an outing a few days ago, and is interesting himself in the proposed electric road between Stroudsburg and Port Jervis.

Santa Fe, N. M.—An ordinance has passed the council which gives the Santa Fe Electric Company the right to construct and operate gas and electric plants for illuminating and other purposes in this city.

Delaware, O.—The city council has granted a franchise to F. M. Marriott, H. W. Hague, F. T. Jones, and S. W. Fowler, permitting them to erect and maintain a Harrison telephone system within the city, provided the work is put in within the next ninety days.

Upper Sandusky, Ohio.—Surveys for the Sandusky Valley Electric Railway were recently begun. After a complete plot is made, the right of way will be asked from the several counties, cities and villages through which the line will pass.

Kansas City, Mo.—The Metropolitan Street Railway Company is remodeling and enlarging its power house at Ninth and Wyoming streets, this city. When this is done electricity for the elevated road will be supplied from this power house.

Manchester, O.—Frank E. Holliday and associates, of New York, have been here looking over the proposed electric road from this place to West Union, the county seat, a distance of ten miles. The road has been surveyed and the work will commence immediately.

Charleston, S. C.—This famous old city, leader in the greatest rebellion that ever convulsed a nation, is away behind in street railway matters. The street cars are still drawn by horses. The council, however, has been applied to for a franchise for an electric tramway.

Lake Helen, Fla.—It is said by those who are in a position to know that Mr. J. B. Stetson, the millionaire hatter of Philadelphia, proposes to build an electric railroad from Beresford, on the St. Johns River, through De Land to connect with the Flagler East Coast system at Lake Helen.

Point Pleasant, N. J.—The South Jersey Street Railway Company, which recently began to operate a trolley road at this resort, is securing a right of way from Bay Head to Lakewood. It is understood that the company intends to cut straight across the country from Lakewood to Trenton.

Little Rock, Ark.—The *Press* of this city says: "The Brown Electric and Machinery Company has recently made heavy sales of telephones in South Carolina, Kentucky, Tennessee, Mississippi, Louisiana and Missouri. The telephones are manufactured in Little Rock. So much for advertising."

Orange, N. J.—The through line of the Suburban Traction Company from Orange Valley and Orange through Watchung Heights, direct to the foot of Eagle Rock, is completed. A 150 H.P. dynamo has been set up in the power house, and supplies ample power to run the cars over the heavy grades.

Oshkosh, Wis.—A final settlement of the affairs of the Oshkosh Electric Light and Power Company has been made and Receiver Paige discharged. The company has been reorganized with A. E. Thompson and George Hilton directors, in place of W. H. Huntington and Thomas D. Grimmer.

Washington, D. C.—The Department of State has received from Consul General Jones, at Rome, a profusely illustrated pamphlet, with translation, giving full details of the plant and appliances used in generating and transmitting 2,000 horse power a distance of eighteen miles across the Campagna from Tivoli to Rome.

Gloversville, N. Y.—The following officers have been elected for the new Amsterdam, Johnstown and Gloversville Railroad Company: President, David A. Wells, of Johnstown; vice-president, Francis Morris, of Amsterdam; general manager, Lawton Caten, of Gloversville; treasurer, James W. Greene, of Gloversville.

Milton, Mass.—A corporation to be known as the Milton and Boston Street Railway is being formed at Milton with a capital stock of $50,000. The company will construct and operate by electricity a street railway from East Milton to Mattapan. A preliminary organization has been made with these directors: A. A. Brackett, J. R. Lawrence, D. J. Brown, W. H. Rice, Milton; J. A. Duggan, T. H. McDonnell and W. P. Pinel, of Quincy.

Toledo, Ohio.—The Robisons will begin soon a new metallic power circuit, which will require the outlay of several thousand dollars. This will be extended throughout the city and furnish power to the various motors now supplied by this company. This is entirely distinct from the street car service and embraces the supply to motors used in seed houses, printing establishments, pattern shops and like service. The decrease in the use of natural gas in these places has greatly increased the demand for electric motors.

Anderson, Ind.—The county commissioners have granted a franchise to N. J. Clodfeller, of Crawfordsville; A. N. Painter, and V. C. Quick, of Alexandria, for an electric railway line through this county. The line projected by the company, which will be known as the Indiana Gas Belt Company, will run from Indianapolis to Marion, a distance of seventy-five miles, passing through Ingall, Fortville, Pendleton, Anderson, Alexandria, Jonesboro, and Gas City. The capital stock of the company is $200,000.

Haverhill, Mass.—Mr. Charles Corliss, of this city, a large real estate owner, is at the head of an electric railroad project which is nothing less than a trunk line extending up the Merrimack Valley from Massachusetts and from the headquarters of the Merrimack to the banks of the St. Lawrence opposite Quebec, and covering in its route the mountain, lake and wild wood regions of New Hampshire and Canada. From this trunk line branches are designed to extend east and west to all points which it is considered desirable to reach.

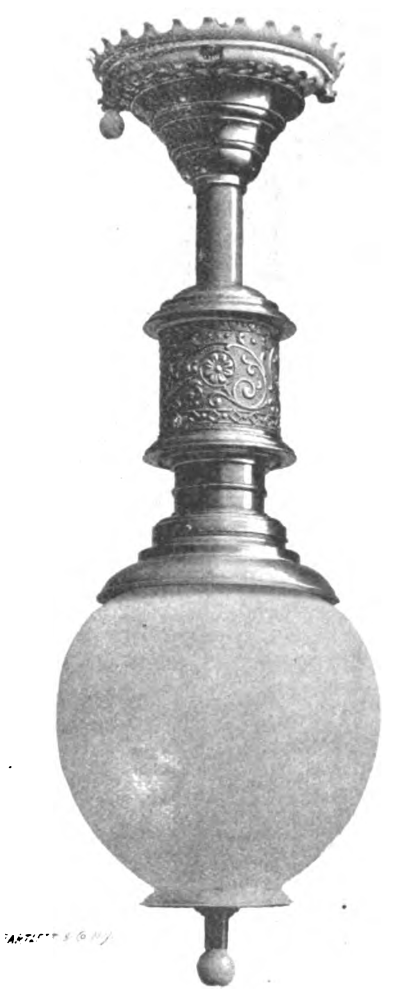
Lawrence, Kan.—A patent has been granted to Lucian L Blake, of this city, for a "system of signaling between an anchored light-ship and a shore station, the combination with telephonic signaling instruments at the shore station, and telephonic signaling instruments on the ship, of an insulated cable extending from the instruments on shore to a point near the anchor, a conducting anchor chain, a transformer interposed between the cable and the chain and having its low resistance coil in circuit with the anchor chain and its high resistance coil in circuit with the cable, and a circuit leading from the anchor chain to a submerged plate over the ship's side and including the instruments on the ship."

Toronto, Can.—The *Globe*, aflame with local pride, remarks: "Boston wants to know why she cannot have Toronto's system of street watering, Chicago would like to take pattern from the Toronto railway franchise, New York is reminded that her telephone costs five times as much as the Toronto one, Omaha uses the steel-broomed street sweeper invented by a Toronto official and first used in this city, and the Paris police have just adopted the Toronto idea of a bicycle police patrol."—The specifications for an electric lighting plant for this city, as prepared by the city engineer, have been completed and issued in pamphlet form, and tenders are advertised for. The specifications call for three triple expansion engines.

Chicago.—The *Inter Ocean* in mentioning the fact that Judge Scales has allowed the assignees of the insolvent estate of the Grant Locomotive Works to rent the factory to the Siemens & Halske Electric Company of America says: "Since the Grant Locomotive Works assigned, about a year ago, the plant has been idle, and a thriving town that was springing up about the factories has been deserted. It is said that the rental by the electrical company means a reorganization and combination of the Grant Company, the Wells-French Car Company, and the Siemens & Halske Company's interests in a great manufacturing center in Cicero."—The Chicago General Railway Company, in a letter to real-estate men interested in land along certain proposed routes, promises that the lines to be constructed will be "equipped with the finest electric trains on earth."

New York.—Dr. T. L. McDermott, of Louisville, Ky., chairman of a committee who are on a tour of investigation of electrical subways and electric light, power and street railway systems, was in the hands of Mr. Hess, the president of the board of electrical control for a few hours, and in an account of his observations says: "We have seen some wonderful things. Mr. Hess took us down into the largest manhole in the city of New York, where there are 22,000 wires laid, each of which is in daily operation. He also took us into the smallest manhole in the city, at the corner of 32d street and Broadway. I understand from him that subways have been built in every principal street in the city, excepting Avenue A and Ninth avenue. He also tells me that there are over 200,000 wires underground in the City of New York—more than in any two other cities in the world."—In its stock review, the *Evening Post* of the 14th says: "Westinghouse July orders were the largest in the history of the company, and footed up $980,000, including the contract for equipment for the United Electric Light and Power Company of New York for several hundred thousand dollars."

Boston, Mass.—Wire Commissioner Murphy has sent notice to the following companies informing them that they must place their wires underground except in cases admitting of exemption permits: Boston Electric Co., Boston Electric and Illuminating Co., Suburban Light and Power Co., Charlestown Gas Co., Brookline Gas Co., Walworth Light and Power Co., Church Green Light and Power Co., Steam Heat and Power Co., Boylston Square Light and Power Co., American Bell Telephone Co., New England Telephone Co., Western Union Telegraph Co., Mutual Union Telegraph Co., Postal Telegraph Co., Commercial Union Telegraph Co., Boston Electric Time Co., Boston District Messenger Co., United Lines Telegraph Co., Postal Telegraph Cable Co., Commercial Cable Co., Mutual District Messenger Co., Financial Telegraph Co., Direct United States Cable Co., Empire and Bay State Telegraph Co., Gold and Stock Telegraph Co., American Press Association, Police Department, Signal Service, Holmes' Protective Association, Holmes' Burglar Alarm Co., Automatic Fire Alarm and Extinguisher Co., United States Electric Fire Signal Co., Boston Automatic Fire Alarm Co., Electric Protective Association, Pulsion Telegraph Co., Telegraph Wire Co., Boylston Telegraph Co.



The Manhattan Incandescent Arc Lamp.

Chesaning, Mich.—At a special election here it was decided to have an electric light and waterworks plant as soon as possible.

The Manhattan Incandescent Arc Lamp.

This lamp, pictured below, has many features that are radical departures from existing types.

The lamp is designed to present the following advantages:

First—Fewness of working parts and decrease in cost of repairs.

Second—Economy in trimming and carbons.

Third—An enclosed globe to act as a spark arrester and to prevent insects from collecting in globes.

Fourth—Susceptibility to artistic design.

Fifth—An arc lamp that would burn singly with economy on incandescent circuits.

Sixth—A lamp that would be generally more regular in feed and positive in cutting out.

The most important feature of the lamp, covered by broad patents, is the inclosed globes. The outer globe is air tight at all points except at the bottom, where there is a hand-hole large enough to permit of cleaning and trimming the lamp. This hand-hole is yieldingly closed by a detachable dust-pan. This is the only practical method of preventing the oxidation of carbons by closure, as it makes it practical to trim the lamp without disturbing any air-tight bearings. The upper opening of the outer globe is secured to the carbon frame and there made air tight by asbestos gaskets, the globe and frame screwing into the body of the lamp.

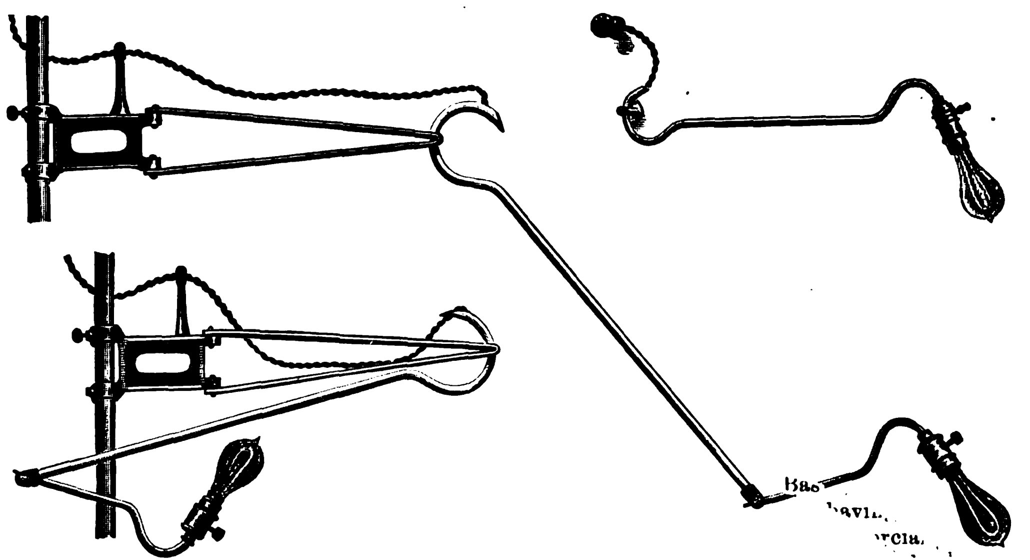
Within this enclosing globe, and immediately surrounding the arc, is a smaller globe into which the carbons are fed, there being, however, no air-tight bearings. The inside globe acts as a chamber of high rarefaction, while the outer globe is a storage for the products of combustion, or diluting chamber, thus preventing access of air containing oxygen to the carbon points. On the formation of an arc, the enclosed air is heated and rarefied, the surplus air escaping through the lower vent. The contained oxygen is soon reduced by combustion with the carbon points to carbon monoxide, and this, with the remaining nitrogen, surrounds the arc and protects the points from further combustion.

By this system of burning of carbons, half-inch carbons, it is claimed, will burn eighty hours without retrimming and without any blackening or discoloration of the globe.

The address of the company is 50 Broadway, New York, and 753 Monadnock Building, Chicago.

The Faries Universal Lamp Holder.

The "Universal Lamp Holder," made by the Faries Manufacturing Company of Decatur, Ill., is one of those useful appliances which commend themselves on sight. The device is patented, and the manufacturers have had a number of them in use in their own shops, and are thus in a position to offer them to users and the trade, guaranteeing them to give great satisfaction. The accompanying illustrations convey an idea of the device and its manner of operation. It is adjustable to any point within the radius of the arm or combined arms, both horizontally and vertically, and is especially recommended for shop, factory and office use. The holder is made of brass tubing [illegible] various sizes and forms, and is finished in black enamel [illegible], or the makers will polish or nickel the brass if the customer prefers.



The Faries Universal Lamp Holder.

The Joseph Dixon Crucible Company.

The Joseph Dixon Crucible Company, Jersey City, N. J., manufacturers of lead pencils, crucibles, stove polish, and other graphite products, have felt the necessity of stiffening the backbones of their salesmen who have complained of competitors' cut prices, and do it after the following fashion. In times like these, when work is none too plenty, and the manufacturer is anxious for orders and the salesman likewise, there is great temptation to cut prices for the sake of getting a quantity of business and thereby deluding ourselves into the idea that we are prosperous because we are busy, forgetful of the fact that the more business one does at a loss the slimmer will be the bank account at the end of the year.

Prices once broken down are hard to re-establish, and it is even doubtful if they can be re-established.

Furthermore, a manufacturer who once gets the reputation of making cheap goods will find it difficult to obtain good prices even for his best goods, and fine products at good prices are always in fair demand at all times.

There is neither money nor reputation to be gained in doing work for less than a fair price, and the very men who profit by beating the salesman down and by inducing him to enter their order at cut-throat competition prices, respect him less and respect his house less than if he had stuck manfully to the principle that first-class goods demand a fair price.

The Gilliland Telephone Company.

The Gilliland Telephone Company of Chicago are meeting with good success in the introduction of their telephone. The instrument is made in a substantial manner and is artistic in form, consisting of Magneto mounted on back-board with desk, Bi-Polar Magneto Transmitter, and Telephone Receiver with cord, and is sold outright at a fair price.

Their Central Office and Exchange System for towns and small cities is complete and comprehensive.

The president, Mr. W. H. McKinlock, and the general manager, Mr. J. J. Nate, have spent the greater portion of their lives in telephone and kindred electrical interests, securing therefrom a broad and valuable experience, which are very necessary factors to the advancement of telephone work, and we believe that with the apparatus which this company are now handling, and the vast opportunities for work in the telephone field, a successful future is assured.

The Ft. Wayne Electric Corporation.

"Every week," says a writer in the New York *Recorder*, "I hear more and more of the success of the Fort Wayne Electric Corporation. At their offices at 115 Broadway there is an air of business prosperity that speaks well for the shrewd management of President McDonald. There is no doubt of the superiority of their goods and they are not afraid to let the world know that they are in the field."

St. Louis as It Was and Is.

Our thanks are tendered to the American Electric Manufacturing Company of St. Louis for a well-filled pamphlet entitled "A Historical and Descriptive Review of St. Louis." The book is neatly printed and filled with handsome illustrations of the numerous objects of note in and around the city, among which are views of parks, bridges, hotels, railroad stations, business houses, private residences and some of the principal streets, etc., all of which show St. Louis to be worthy of the reputation she has of being among the most splendid cities of the republic and one of the most progressive.

The statistics given attest the commercial importance of the city in manufacturing, finance and trade, and in the electrical business she occupies an advanced position alike in the character of the articles produced and the celerity with which the citizens avail themselves of the latest improvements. There are 500 men employed in electrical work.

The American Electric Manufacturing Company may well feel a pride in the city in which they are located, and to whose business repute they are contributing by the manufacture of incandescent lamps surpassed by none in the country.

COMMERCIAL PARAGRAPHS.

The Siemens & Halske Electric Company of America, although momentarily obstructed by the destruction of its Chicago works, is rapidly resuming business. Since the fire this company has closed six contracts for various classes of machinery, of which the two most important are the Hotel Savoy, New York, for a large lighting plant, and Franklin MacVeagh & Co., in Chicago, for a power transmission plant.

The Mather Electric Company of Manchester, Conn., report the sale, through Harry S. Smith & Co. of Philadelphia, of two 45 K. W. direct connected dynamos for the Bartram Apartments of that city. These dynamos are to be of the new Mather multipolar type, directly connected to Woodbury engines, and when completed this will be one of the finest direct connected plants in Philadelphia.

The Metropolitan Electric Co. received some pretty good orders for I. X. L. Triple Braid Wire during the last week, among the number being one for thirteen miles and one for ten miles, large sizes. This wire is coming into prominent notice in the West, being already a favorite in the East, and the Metropolitan Electric Company carry a large supply always on hand to enable them to fill orders without delay.

The Mather Electric Company of Manchester, Conn., report the shipment last week of a car-load of electrical apparatus, consisting of one 250 light dynamo and ten 8 H. P. Manchester type slow speed motors, with special starting boxes, to the Massachusetts State Insane Asylum at Danvers. The motors will be used for operating ventilating fans throughout the building, the whole installation being in the hands of G. M. Angier & Co., of Boston, New England contractors for Mather apparatus.

Messrs. Williams, Tod & Co., of Youngstown, O., who built the engine for the Ferris Wheel at the Fair, have built and shipped to the Brooklyn Edison Company, for their Pearl street station, a large engine, which it is believed will open the way for its makers to get a good share of the business in the electrical field.

It is of 1,200 H. P., 130 revolutions, of the compound marine type, with three cylinders. The fly wheels weigh 1,800 lbs. each. It is coupled direct to the Edison multipolar machines.

INCORPORATIONS.

The Monarch Engine-Stop Company (incorporated in W. Va.), New York City—to manufacture, buy and sell steam, electrical and other engines, machinery and machines, engine-stops, etc. Capital stock, $250,000. Promoters: Leonard W. Sweet, Jos. Livingston, New York City; Chas. A. Benton, Riverdale, N. Y.

The Citizens' Electric Light and Power Company, Pensacola, Fla.—to operate electric light and power plant for supplying electric power for lighting, heating and mechanical purposes. Capital stock, $20 000. Promoters: T. E. Welles, S. C. Cobb, Chas. J. Heinberg, Pensacola.

The Crown Point Electric Company, Crown Point, Ind.—to own and operate a light, heat and power plant in Crown Point, Ind. Capital stock, $10,000. Promoters: Geo. K. Wheeler, E. S. Tice, O. H. Olsen, Crown Point.

The Akron Insulator and Marble Company, Akron, Ohio—to manufacture and deal in insulators, tubing, electrical machinery, appliances, goods, specialties, etc. Capital stock, $20.000. Promoters: Jas. P. Loomis, Albert L. Bouman, Adelbert L. Daniel, Jas. P. Hemphill, Samuel C. Dyke.

The Ohio Metal Company, Norwalk, Ohio—to deal in and manufacture metal goods, gas and electrical fixtures, etc. Capital stock, $25,000. Promoters: E. F. Rowley, W. H. Price, Jas. G. Gibbs, Geo. T. Thomas, N. O. Allen, F. A. Powers, R. K. Rood.

The Lancaster Railway Construction Company, Trenton, N. J.—to build, construct and furnish material for the construction of electric and steam railroads. Capital stock, $100,000. Promoters: Henry Baumgardner, Michael Reilly, Geo. N. Reynolds, Jno. E. Hubley, Frank H. Steacy, David B. Shenk, Lancaster, Pa.; Hugh E. Crilley, Allentown, Pa.; Theo. Mace, Trenton, N. J.

The Gilmore Water and Electric Light Company, Independence, Oregon—to furnish water for domestic and other purposes, electric light, heat and water or electric or other power. Capital stock, $30,000. Promoters: L. C. Gilmore, J. S. Cooper, J. A. Veness, D. B. Taylor, J. M. Vanduyne, A. S. Locke, Independence.

The Boston Automatic Fire Alarm Company, Portland, Maine—to manufacture and deal in electric fire and burglar alarms. Capital stock, $250,000. Promoters: E. S. Cowles, Jersey City, N. J.; Edwin Sheafe, Boston, Mass.; W. O. Underwood, Lynn, Mass.

The Co-operative Electric Railway Company, Chicago, Ill.—to acquire, sell, lease or operate railways; to buy, use or operate franchises for the same, to manufacture, sell or operate patents protecting electric railway equipments, and to do any business for the best interests of the company, etc. Capital stock, $1,000,000. Promoters: Morris S. Evinger, Chas. E. Nurnap, Isaac T. Dyer.

The Citizens' Electric Company, Springfield, Ill.—to produce and furnish electricity for light, heat and power, and to use and furnish electrical appliances and electrical discoveries now in use or hereafter to be discovered. Capital stock, $60,000. Incorporators: John McCreery, Fred. D. Buck, L. H. Coleman, P. W. Harts and Edwin A. Wilson.

The Chelsea Electric Light Company, Chelsea, Mich. Capital stock, $25,000. President, Chas. M. Davis; vice-president, Archie W. Wilkinson; treasurer, Frank P. Glazier; general manager, A. R. Welch. Most of the stockholders are connected with the Glazier Stove Works.

The Seashore Electric Company, Asbury Park, N. J.—to supply the people of Asbury Park with electric lights and electric power for mechanical purposes. Capital stock, $100,000. Incorporators: J. C. Shaffer, president of the Seashore Electric Railway Company; W. H. Shaffer and Isaac C. Kennedy.

The Charles F. Rich Company, Detroit, Mich.—to manufacture and deal in gas and electric light fixtures. Capital stock, $20.000. Incorporators: Wallis Boileau, of Philadelphia, and Frederick Linsell and Charles F. Rich, of Detroit.

The Mercantile Carbon Company of New York City—to manufacture a new electrode for arc lamps. Capital stock, $50,000. Directors: Albert C. Seibold, of Mt. Vernon, and Henry Hoyt and S. M. Comstock, of New York City.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED AUGUST 14, 1894.

ELECTRIC RAILROADS AND APPLIANCES.

524 366. Electric-Railway System. Theodore B. Wilcox and Henry Wilcox, Newark, N. J. Filed Aug. 1, 1893.

524,367. Electromagnetic Contact-Making Device for Electric-Railway Systems. Theodore B. Wilcox and Henry Wilcox, Newark, N. J. Filed Aug. 1, 1893.

524,368. Electric-Railway System. Theodore B. Wilcox and Henry Wilcox, Newark, N. J. Filed Aug. 16, 1892. Renewed Aug. 1, 1893.

524,434. Conduit-Cleaning Device. Charles O Ehlert, New York, N. Y. Filed Aug. 22, 1893.

524,517. Trolley-Wheel and Support. David R. Thomas, Baltimore, Md., assignor of one-half to William F. Harendt, same place. Filed May 26, 1894.

524,532. Switch for Electric-Railway Cars. Timothy A. Remsen, Brooklyn, N. Y. Filed June 2, 1893.

524,672. Trolley-Wire Switch. Johan M. Andersen, Boston, Mass., assignor of one-half to Albert Anderson, same place. Filed April 26, 1894.

ELECTRIC LIGHTS AND APPLIANCES.

524,305. Arc-Lamp Post. Richard R. Bowker, New York, N. Y. Filed June 22, 1894.

524,357. Electric-Arc Lamp. Otto H. Swoboda, New York, N. Y., assignor to Sigmund Bergmann, same place. Filed July 19, 1893.

524,388. Electric Search Light. Edward R. Knowles, Middletown, Conn., assignor to the Schuyler Electric Company of Connecticut. Filed Jan. 9, 1893.

524,462. Arc Lamp. Robert Drysdale, Everett, Mass. Filed Jan. 14, 1893.

MOTORS, DYNAMOS, ETC.

524,373. Regulation of Dynamo-Electric Machinery. Edward M. Bentley, Boston, Mass. Filed Dec. 26, 1890.

524,376. Compounding Motor-Generators. James Burke, Schenectady, N. Y., assignor to the General Electric Company, Boston, Mass. Filed June 5, 1894.

524,378. System of Electrical Distribution. Thomas A. Edison, Llewellyn Park, N. J. Filed Dec. 6, 1886.

524,381. System of Power Distribution and Regulation. John W. Gibboney, Lynn, assignor to the General Electric Company, Boston, Mass. Filed Oct. 21, 1893.

524,3 5. Controller for Electric Motors. Joseph H. Jenkins, Lynn, assignor to the General Electric Company, Boston, Mass. Filed Feb. 3, 1894.

524,396. Controller for Electric Motors. William B. Potter, Lynn, assignor to the General Electric Company, Boston Mass. Filed Dec. 21, 1893.

524,407. Electric Motor. William L. Silvey, Dayton, Ohio.

524,426. Electromagnetic Motor. Nikola Tesla, New York, N. Y., assignor to the Tesla Electric Company, same place. Filed Oct. 20, 1888. Filed March 2, 1894.

524,533. Dynamo-Electric Machine or Electric Motor. Alonzo B See and Walter L. Tyler, Brooklyn, N. Y. Filed May 10, 1894.

524,534. Alternate-Current Motor. William Stanley, Jr., Pittsfield, Mass., assignor to the Stanley Laboratory Company, same place. Filed April 13, 1892.

524,615. Motor-Regulator. Joseph F. Sheahan, New York, N. Y. Filed May 28, 1894.

TELEPHONE AND TELEGRAPH APPARATUS.

524,480. Telephonic System. Henry A. Chase, Boston, Mass., assignor to Albert Watts, same place. Filed April 16, 1894.

524,521. Telephone-Transmitter and Resistance Varying Material Therefor. Frank R. Colvin, New York, N. Y. Filed Oct. 10, 1893.

524,635. Telegraphic Transmitter. Frank F. Howe, Marietta, Ohio. Filed Jan. 15, 1894.

BATTERIES.

524,374. Battery-Changer for Electric Circuits. Charles Bernhardt, Chicago, Ill., assignor of one-half to William H. Altman, same place. Filed Nov. 23, 1891. Renewed Jan. 19, 1894.

524,656. Electrical Storage-Battery. Burton C. VanEmon, San Francisco, Cal., assignor to Geo. H. Roe and Gustav Sutro, same place. Filed Nov. 6, 1893.

MISCELLANEOUS.

524,343. Electrical Conductors. Edwin D. McCracken, Alpine, assignor to the Norwich Insulated Wire Company, Harrison, N. J. Filed Nov. 29, 1893.

524,382. Rheostat. Albert B. Herrick, Schenectady, N.Y., assignor to the General Electric Company, Boston, Mass. Filed May 22, 1893.

524.383. Bus-Bar Switch for Central Stations. Albert B. Herrick, Schenectady, N. Y., assignor to the General Electric Company of New York Filed June 9, 1894.

524,384. Double-Throw Snap-Switch. Edward M. Hewlett, Schenectady, N. Y., assignor to the General Electric Company, of New York. Filed July 2, 1894.

524,386. Electric Time-Recorder. Harry T. Johnson, Elizabeth, N. J. Filed Dec. 26, 1893.

524,467. Insulating-Turnbuckle. Henry H. Luscomb, Hartford, Conn. Filed June 5, 1894.

524,518. Automatic Electric Signaling Device. Edward A. Hermann, St. Louis, Mo. Filed April 16, 1894.

524,630. Automatic Circuit-Breaker. Anatole C. Carles, Portland, Me. Filed April 14, 1894.

524,636. Induction-Coil. Charles L. Jaeger, Maywood, N. J. Filed Jan. 18, 1894.

524,616. Electric-Heater. Charles H. Newbury, St. Paul, Minn., assignor of one-half to John J. Borum, same place. Filed April 19, 1894.

524,659. Insulator. George H. Winslow, Pittsburg, Pa. Filed Dec. 8, 1893.

521,684. Insulating-Turnbuckle. Louis McCarthy, Boston, Mass. Filed June 13, 1894.

ELECTRICITY.

VOL. VII. NEW YORK, AUGUST 29, 1894. No. 7

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EDITORIAL NOTES.

The British Association. The annual meetings of the British Association and of the American Association for the Advancement of Science were held almost simultaneously this year, the one at Oxford, the other in Brooklyn. These two meetings suggest comparisons, but we fear this is a case where comparison would be odious to Americans. The attendance at the B. A. meetings aggregated over 2,000 people—probably five times as many as attended the Brooklyn sessions, which seems to show that Englishmen take more interest in scientific studies than Americans.

The American Association ignored the science of electrics, and there was, therefore, no reason why its proceedings should be reported in electrical journals.

At Oxford the main features of the programme were papers bearing upon electrical subjects in the various sections, if we except the presidential address of Lord Salisbury, who spoke not as a scientist but as a layman, but whose remarks were of intense interest to his immediate audience, and to the wider audience, who have since read it. A comparison suggests itself here which cannot be smothered. What politician or statesman have we in public life in America capable of preparing a paper of this nature on a par with Salisbury's ?

Prof. Rücker's address before Section A is reprinted in part elsewhere in this issue. It deals with some phenomena of terrestrial magnetism, and with the needs of the science. The thoroughness and enthusiasm of the author are manifest throughout, and the paper presents many facts not hitherto considered by students in this branch of science. We are not surprised to learn that the large lecture theatre where the lecture was delivered was crowded to overflowing, and that Lord Kelvin moved a vote of thanks to the lecturer.

The abstract of the discussion on Lord Kelvin's paper on "Preliminary Experiments to Find if Subtraction of Water from Air Electrifies It," which we are also able to present along with the paper, shows the independence of the British mind. The members of the B. A. are evidently unwilling to accept even Kelvin's conclusions without doing considerable thinking on their own account.

Mr. Parker's description of the Oxford lighting station is scarcely a scientific paper, but it shows what scientific practice can accomplish in central station economy. We wonder how many American stations, operating in similar territory, can show equal financial results? Mr. Parker states that, although for the greater part of the year only half-load was required, the coal consumption had averaged but 6.38 lbs. per unit sold, and the revenue had been 10s. 11d. for each 8 C. P. 35 watt lamp; supplies, management and office expenses having cost 5.249d. per unit. The year had begun with 5,060 lamps connected, the number having increased to 7,774 on June 30.

It is evident that we have not correctly estimated the sense of humor possessed by our British cousins. The only spark of fun at the Brooklyn meeting seems to have been a ghost hunt conducted by two or three men of science; whereas at Oxford, unless the programme is misleading, there was a perfect fusillade aimed at the respective audiences, in the various sections, of funny papers—perhaps we should say scientifico-humorous papers. For instance, Mr. Swinburne dealt, not with the hunting of ghosts, but with "The Hunting of Governed Engines." Mr. Preece cracked true British jokes about his siren, which screeched once and could never be made to do it again. The anthropological section giggled over A Paper on the Significance of Ticklishness, and grew sentimental over one on Shoe-throwing at Weddings. There was also a paper on "The Philosophy of Holes."

The average of the papers was high, and we congratulate our British friends on the success of the meeting. Nothing in the nature of startling discoveries was made known, if we except the claim of Lord Rayleigh and Prof. Ramsay, in the chemical section, to the discovery of a new element in the atmosphere, and this claim has not yet been verified; it is in fact received with some skepticism both in England and America.

The New Units in Practice.

Electricity was all along opposed to the introduction of new terms into electrical nomenclature. We have given many reasons for our opposition, chief of which was the confusion which would inevitably result. Now we learn from the London *Electrician* that the leading men in the profession at the meeting of the British Association got into a perfect mess of discord and contention because they did not use correctly the names of some of the units of recent adoption, and that an entirely useless discussion was occasioned by the ignorance of the participants as to what they themselves were talking about: "Prof. S. P. Thompson also sinned by appropriating the word 'reactance' to express the idea usually conveyed by the word 'impedance.' An alternating current, he said, is determined by the ratio of the electromotive force to the reactance! Now, not only have Oliver Heaviside and other mathematicians employed this word 'reactance' to express only that term in the impedance expression which is due to magnetic induction, but this meaning of the word has become fairly generally adopted, and it has even been authoritatively accepted in America. Prof. Thompson's act in annexing the word to express what everyone else knows as 'impedance' is therefore liable to lead to confusion." We should say so.

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The Golden Rule: A Sample Case.

Reference was made last week to Mr. Coffin's Pecksniffian declaration at Boston that both his company and himself had been in the habit of acting in accordance with the Golden Rule in their treatment of the Edison Licensees.

The remark sounded well to those, if there were any, who could believe it. But it was regarded as a vagary of a diseased mind by the great majority who were in position to contrast the acts of the company with the honeyed words of the President.

We will cite one case where Mr. Coffin, or some one else, put the Golden Rule into practice for the company.

There have been for a number of years two lighting stations at Atlantic City. One is an Edison Licensee, the other was originally equipped with United States apparatus, afterwards adopting the T.-H. arc-lighting system. Neither one has been over-prosperous, yet both have earned a little more than operating expenses. The Edison station had both a moral and legal right to claim that the General Company should not sell to their competitor any apparatus for incandescent lighting, and they relied on their rights. They also went to the Westinghouse Company, and as a matter of justice to invested capital the latter agreed not to sell incandescent apparatus to the T.-H. station, although under no obligation of any kind.

Then without warning or discussion with the local Edison people, Mr. Mullins, of the Philadelphia office of the G. E. Company, sold to the T.-H. station an alternator, with which they proceeded to cut into the Edison territory. Mr. Coffin had been appealed to, and had written over his own signature that the order should be cancelled and the machine should not be shipped. This letter is in evidence. However, as stated, the machine was shipped, and has been in operation for some time to the great detriment of the Edison Licensee station.

We rather expect the Licensees in this instance to find out, in a court of law, just how much damage they have sustained through the application of the Golden Rule by the General Electric Company.

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An Independent Company.

True independence for all mankind has been for centuries the dream of philosophers, the goal which reformers have striven for, the sum of the patriot's ambition in all countries. Men differ as to what constitutes independence, either of the State, the individual, or the corporation; they also differ as to the best means by which to attain it, but they all agree that the millennium will not be possible without it. The fact that American business concerns have been up to a recent date absolutely independent in the conduct of their business has been the most important feature in the development of our commerce. When we see, therefore, a single company, in this age of trusts and trade arrangements, manifesting its absolute independence in every feature of its policy and conduct, we feel that this company merits special mention—that it should be held up before its competitors and customers as a bright example. Such a company is the Brush Electric Company of Cleveland. Our statement will, perhaps, cause surprise in certain quarters. There may be some skeptical souls who will refuse to believe it. But it must be so, because the Brush Company acknowledges it. This should be all the evidence required, but new proof was furnished last week, when Mr. Charles T. Hughes made affidavit to the fact that he is manager of the Eastern District office of the General Electric Company; that he is in the habit in the regular course of his business, and according to instructions from his superiors, of putting in bids for apparatus both as manager for the General Electric Company and as Eastern agent for the Brush Company of Cleveland.

Thus intending purchasers of apparatus may know that the bids of the G. E. Company and the Brush Company are competitive in the fullest sense, and that the Brush Company is honestly and truly independent.

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General Electric.

History repeats itself, and it has repeated itself more often in the brief career of the General Electric Company than in any case on record.

When the stock was selling at 115-119 the insiders and their subsidized touts were shouting that it would go to 150; meantime both C. A. Coffin and Drexel, Morgan & Co. were going short of the stock. Almost every month during the past two years the performance has been repeated. Something of the kind is going on just now, but we note a decreasing vehemence in the claims for the property.

The fact is, and the main body of the stockholders will realize it some day, that the company's condition is hopeless. They are doing at the rate of less than eight millions of business, and it would take twenty millions at fair prices to enable them to show any profit. At the prices they are selling for, they are losing money every week. The treasury is nearly empty of assets, and all talk of dividends being resumed is the veriest rot. The payment of any dividend whatever is an absolute impossibility under the law until reorganization has taken place and the $14,000,000 impairment of capital made good.

The company has no organization and the entire outfit is utterly demoralized. There is no head to the business, nothing but bickering and strife among the half-dozen petty officers. Mr. Coffin, the only man of brains in the lot, has been stripped of all power and compelled to advise with men like Ord and Greene regarding the ordinary details of the business. Recently Mr. Coffin was compelled to suffer the humiliation of arguing with the Board for three hours to get a $270 bill paid to one of his young men. There is nothing but contention and discord from top to bottom in the company.

This sort of thing does not breed *success*.

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A dazzling illustration in the *World* of last Sunday shows a short-haired and ancient looking maiden (said to be Miss Meg Merrilies) flashing light from her body while engaged in taking "a million volts of electricity." There is a page of description of which this is a fair sample:

> Susceptible youths have told me, time and again, that I looked like an angel, but this is the only time I have ever felt the part. I am exhilarated by my own radiance, far more exhilarated than I was by the mere playing with the fire. I wonder whether I shall retain to the end of my days the glory that is upon me.
>
> A grateful warmth steals through my veins. I feel as light and airy as if I were floating 'twixt the arch of heaven and the earth. And, in anticipation of holding my glory for all time to come, I see in my imagination men bow down in worship, as those before the throne of "She."

If she ever said half as much to Tesla it is a safe bet that he fainted dead away.

Before the season is over we shall see similar pictures on the bill-boards, and then we will all know that the dime-museums have a new attraction—the Bearded Lady, the Dog-Faced Giant and the Seven-Legged Chicken must all give way to the Electrical Man who takes a million volts and shoots showers of fierce flames without wincing.

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A lively discussion was carried on in the London *Lancet* for some weeks on the use of electricity in the treatment of trigeminal neuralgia. Prof. Rose described two cases in which surgical operations had been resorted to, electric treatment having been ineffectual. Dr. Julius Althaus defends the science of electro therapy, and recommends for neuralgia, the application of the continuous current for some thirty to sixty minutes at a time, repeated daily for two or three weeks. If the electric current cannot cure neuralgia in less than three weeks, we think it will have to stand aside in favor of the morphine pill or the guillotine. There is such a thing as paying too high a price even for life itself.

At present internal dissensions exist betw en the Boston and New York end of the Trust, with the Boston group on top.

The above is from a two-column article on Trusts in the reading matter columns of the Boston *Herald*. We locate it thus exactly because we know that the gentleman who edits the financial columns of the *Herald* would not like to assume the responsibility for so erroneous an opinion. The Boston group are on top in about the same way that Paddy, in the well-known story, bested his adversary by lying flat on his back while the latter sat on him, claiming that he could always fight best in that position. We recommend the news editor of the *Herald* to refer all his G. E. matter to Mr. Hosmer, who knows a thing or two.

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Hon. George B. Shaw, who died at his home in Eau Claire on the 27th, was well known to a great many electrical men, having had charge of the Ansonia Company's World's Fair Bureau last year. He was a successful politician, and left a wide circle of friends. He was Supreme Chancellor of the Order of the Knights of Pythias from 1890 to 1892.

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There seems to be no doubt that Mr. R. T. McDonald and the Fort Wayne Electric Corporation are in shape to drive the final nails into the coffin of the General Electric Company. They are already well organized and will soon be in the railway field. The former friends and supporters of Mr. Coffin in New England are in active sympathy with Ft. Wayne.

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It is expected that the stockholders of the Ft. Wayne Electric Company will receive a disbursement of from $4.50 to $6 per share before October 1. This does not apply to the General Electric Company, which seems in a fair way to realize nothing whatever from the Ft. Wayne property.

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The twin lamps of the Electric Construction and Supply Company, now used by the Brooklyn Edison Company for their street lighting, mark a distinct advance in the art, and reveal new possibilities for incandescent lighting stations. We expect to hear more of Mr. John Knight, the inventor.

Knapp Electrical Works in Trouble.

It is reported from Chicago, as we go to press, that Mr. Myron A. Knapp, of the Knapp Electrical Works, has confessed judgment in the sum of $29,000 in favor of his father.

The Power of the Age.

(From the Toronto Empire.)

ELECTRIC RAILWAY FOR SALE.

Electricity is the power of the age and for street railway traffic it has practically superseded every other motive power. The electric railways throughout Ontario have been such a pronounced success that there will doubtless be a rush of capitalists to obtain the electric railway of New Westminster, B. C., and extending from that city to Vancouver, the sale of which is announced through *The Empire's* advertising columns.

We have not learned that any considerable body of capitalists rushed to the Pacific Coast to be let in on the ground floor of the great electrical enterprise connecting New Westminster and Vancouver, B. C. Electricity is, however, the power of the age.

Brooklyn Electrical Society.

The above-named society has resumed its regular meetings, which will be held this winter in the rooms of the Brooklyn Edison Company, through the courtesy of Mr. W. S. Barstow. The first meeting for this season was held at the home of Mr. Ira G. Hoagland, 427 Eighth street, when several new members were admitted. The course of lectures provided is a good one.

EUGENE PHILLIPS'S CLAMBAKE.

Men may come and men may go; times may be good or bad; business may be booming or languishing, but the generous hospitality of the American Electrical Works diminisheth never. For the sixteenth year in succession Mr. Eugene F. Phillips, that prince of good fellows, in conjunction with his colleagues, had sent out invitations through the length and breadth of the land calling together the workers in the great electrical field to eat, drink and be merry at the well-known trysting place where the succulent bivalve, known the world over as the clam, can be manipulated, served and eaten in more dainty fashion than anywhere else in the world. As all our readers know, this place is Haute Rieve, near Providence, where the annual clambake of the American Electrical Works was given on Saturday, the 25th.

The gathering this year was somewhat larger than usual in numbers; a wee bit less rollicking than usual, yet withal a gay and festive throng, whose unanimous intent was, for the time being, "to drive dull care away," and let the Tariff Bill, the thieving Senators and the grasping Sugar Trust take care of themselves.

After the preliminary lunch there was a ball game between the Boston and Providence teams, in the playing of which some pretty work was done by the Hubites, who eventually vanquished their opponents by a score of 26 to 6. Meantime in the lunch room that inevitable football had been set a-rolling, to the discomfiture of innumerable hats and bare heads, including also a somewhat badly sprained ligament in the right leg of Mr. F. E. Donohoe, Chicago representative of the American Electrical Works.

For the less youthful and active members of the party there were various quiet amusements provided, including target practice, "putting the hammer," etc., etc. The patriarchs in the party preferred to sit smoking on the piazza, listening to the orchestra, until all were summoned to assemble on the crest of the hill to have their inevitable photograph taken.

Now the clams and their fixings were ready to be served at table and the crowd soon disaplayed their capacity for enjoying Rhode Island's favorite dish. It was a beautiful and typical feast withal; nothing lacking to make it a perfect all-round "bake," such as can be partaken of nowhere else on earth. Over the exercises at the well filled tables, under an enormous tent, Mr. Phillips himself presided in his usual happy manner. Mr. C. W. Price, of New York, acted as toastmaster, and called upon the distinguished guest of the day, Hon. J. C. Wyman, of Valley Falls.

Mr. John I. Sabin, of San Francisco, an intimate friend of Mr. Phillips, and the gentleman who first suggested these annual clambakes, spoke entertainingly in a reminiscent vein.

Mr. A. S. Hibbard, of Chicago, then responded with a little song, which was much enjoyed and evoked loud cries for "more." Frank Ridlon called for a rising vote of thanks to the American Electrical Works, which was promptly adopted with musical honors.

This concluded the exercises round the tables, after which the fun was resumed in the lunchroom and on the lawn until the hour of departure.

In providing this pleasure for so large a party of visitors, Messrs. Hathaway, Ackerman, Carroll and Donohoe were unremitting in their attentions and labors, and there was a universal sentiment of regret that Mr. Remington was unavoidably absent through sickness.

THOSE PRESENT.

C. E. Stunp, New York.
G. H. Phillips, Norwich.
G. M. Fernald, Boston.
E. P. Shaw, Newburyport.
Daniel Chalmers, New York.
W. F. Weber, Norwich.
S. L. Miller, Narraga't Pier.
R. A. Ripley, Boston.
H. L. Chatterton, Pro'dence.
T. H. Biffer, Boston.
R. E. Breck, Bridgewater.
G. H. Thurston, Providence.
F. E. Gibson, Carlton.
S. W. Clapp, Boston.
F. C. Gifford, Waltham.
C. S. Pettman, Chelsea.
G. B. Lamder, Concord.
D. L. Mitchell, Taun'on.
G. Livermore, Boston.
W. F. Downer, Canton.
G. C. Allen, New York.
E. Holmes, Providence.
F. J. Coburn, Chelsea.
H. G. Tuckerman, Boston.
F. S. Palmer, Boston.
E. L. Perley, Salem.
F. J. Boynton, Boston.
P. H. Alexander, New York.
H. A. Howard, Boston.
S. Alger, Bridgewater.
H. J. Lockwood, Newport.
F. N. Phillips, Providence.
G. Cameron, Boston.
J. O. Darling, Providence.
V. A. Thomas, Providence.
A. C. Day, Lynn.
C. Phillips, Attleboro.
F. S. Renfield, New York.
C. L. Frisbie, New Britain.
W. H. Sawyer, Providence.
F. C. Robbins, Boston.
A. D. Blodgett, Boston.
P. C. Ackerman, New York.
C. O. Baker, Jr., Newark.
C. W. Price, New York.
H. W. Pool, New York.
W. S. Key, Boston.
W. C. Fales, Pawtucket.
H. M. Bullard, Boston.
C. R. Dey, Boston,
C. Q. R. Ring, Boston.
R. W. Smith, Boston.
C. T. Seifert, Pawtucket.
W. D. Shortwell, Boston.
D. A. White, Concord.
G. G. Garrish, Fall River.
H. W. Jones, New Bedford.
R. H. McCabe, Boston.
James Bradley, Boston.
C. Sylvester, Fall River.
G. A. Sterre, Providence.
John Carroll, Montreal.
A. S. Hibbard, Chicago.
W. H. Babcock, Hartford.
H. F. Woods, Boston.
A. A. Ziegler, Boston.
R. L. Tuft, Boston.
E. Stone, Providence.
A. Otis Smith, Boston.
T. J. Many, Chicago.
C. McLaughlin, Boston.
F. E. Walker, River Point.
J. Tregoning, Attleboro.
H. A. Perrin, Pawtucket.
J. I. Sabin, San Francisco.
R. H. Whithers, Providence.
W. C. Langford, Providence,
T. K. Hutchins, Providence.
C. L. Luther, Pawtucket.
G. H. Farr, Enfield, Conn.
W. G. Hartford, Pawtucket.
F. H. Peckham, Providence.
F. A. Swain, Wakefield.
F. E. Chaffee, Providence.
W. H. Dempster, Providence.
W. P. Gannett, Jr., Prov'dce.
W. D. Wright, Providence.
G. A. Stetson, New Bedford.
J. W. White, Providence.
A. D. Wheeler, Boston.
F. C. Perkins, Manchester.
W. C. Preston, Providence.
J. Christie, Boston.
H. A. Cleverly, Philadelphia.
Warren S. Hill, Boston.
F. C. Mason, Brooklyn.
R. B. Pratt, New York.
E. A. Chapel, Chelsea.
W. T. Thurston, Providence.
F. C. Hand, Scranton.
H. E. Hall, Boston.
F. C. Corbin, Cincinnati.
E. F. Tremaine, Brockton.
S. B. Condit, Boston.
D. K. Carpenter, Brockton.
F. G. Hill, Waltham.
G. Wilmot, Newburg.
G. W. Warde, Concord.
W. P. Brown, Boston.
F. B. Whitin, Whitinsville.
G. H. Darling, Providence.
M. P. Burbank, Whitinsville.
W. A. Cook, Boston.
F. P. Hoffman, New York.
G. R. Lean, Cleveland.
H. H. Day, Boston.
C. G. Burleigh, Boston.
C. Odell, Salem.
E. R. Tilton, Boston.
C. A. Clark, Boston.
D. L. Scott, New York.
R. B. Brown, Boston.
R. O. Greene, Boston.
A. Neilson, Boston.
P. Fahey, Boston.
S. Young, Lowell.
G. A. Wall, Providence.
L. S. Urquhart, Lynn.
S. L. Thurston, Providence.
J. A. Bastom, Attleboro.
C. S. Jones, New Britain.
Orin Smith, Jr., Pawtucket.
James A. Welsh, Pawtucket.
L. M. Clarke, New Haven.
F. S. Mead, Montreal.
A. C. White, Providence.
W. H. Sargent, Brooklyn.
E. F. Phillips, Providence.
H. H. Sherman, Auburn, R.I.
N. B. Kinson, Pawtucket.
C. F. Baker, Boston.
D. Mitchell, Boston.
J. M. Ditson, Boston.
W. K. Warner, New Bedford.
E. A. Colby, Newark, N. J.
F. P. Costello, Boston.
J. E. Fenley, Boston.
D. A. Harrington, Boston.
G. H. Olin, Fall River.
Frank Ridlon, Boston.
H. B. Cram, Boston.
J. W. Roche, Worcester.
P. E. Waters, Brockton.
W. M. Brophy, Boston.
J. F. Beck, Providence.
J. Andrews, Boston.
F. H. Thomas, Chicago.
W. W. Lillie, Boston.
G. Sawyer, Boston.
E. R. Phillips, Providence.
B. F. Leavitt, Providence.
F. E. Donohoe, Chicago.
L. A. Ferguson, Chicago.
E. B. Barker, New Haven.
W. A. Munro, Providence.
E. C. Perkins, Providence.
W. A. Hathaway, Providence.
F. J. Hovey, New York.
W. J. Barnes, Providence.
S. R. Payson, Providence.
G. H. Preble, Providence.
John I. Drake, Providence.
F. C. Holst, Providence.
H. G. Martin, Providence.
L. R. Willis, Wakefield.
G. Heathcote, Providence.
S. B. Allen, Providence.
— Allsopp, Providence.
F. B. Batch, Providence.
S. Smith, Boston.
J. C. Wyman, Valley Falls.
C. G. Peterson, Providence.
F. B. Barker, Providence.
C. H. Barney, New York.
David Boynton, Chicopee.
J. S. Keenan, Boston.

The British Association.

Annual Meeting at Oxford—Summary of Closing Proceedings—Interesting Papers.

(*Special from our London Correspondent.*)

The attendance at the sessions has increased, reaching on the 10th inst. nearly 2,500 people. Interest in the proceedings has been well sustained and the papers have been, as a rule, above the average. In addition to those mentioned in our report of last week, the following have been presented:

Experiments to find if subtraction of water from air electrifies it, by Lord Kelvin and others.

Preliminary experiments for comparing the discharge of a Leyden jar through different branches of a divided channel, by Lord Kelvin and Alex. Galt.

Continuous current distribution of electricity at high voltage, by Thos. Parker.

A new analytical representation of terrestrial magnetism, by Dr. Adolph Schmidt, read by Prof. Schuster.

A suggested explanation of secular variations of terrestrial magnetism, by Prof. Schuster.

Construction of delicate galvanometers, by Prof. Schuster.

Minimum current audible in telephone, by Lord Rayleigh.

An attempt at a quantitative theory of the telephone, by Lord Rayleigh.

Volume-charges accompanying magnetization in nickel tubes, by Dr. Peddie.

Hysteresis of iron and steel in rotating magnetic fields, by F. G. Baily.

Mirrors of magnetism, by Prof. S. P. Thompson.

Advantages of alternate currents, by Prof. S. P. Thompson.

Signaling through space, by W. H. Preece, C. B., etc.

A special chronograph, by H. Lea and R. Bragge.

Some very interesting experiments on the electrolysis of glass were described by Prof. Robert Austen.

Preliminary Experiments for Comparing the Discharge of a Leyden Jar through Different Branches of a Divided Channel.*

BY LORD KELVIN, P.R.S., AND ALEX. GALT, B.SC., F.R.S.E.

In these experiments the metallic part of the discharge channel was divided between two lines of conducting metal, each consisting in part of a test wire, the other parts of the two lines being wires of different shape, material, and neighborhood, of which the qualities in respect to facility of discharge through them are to be compared.

The two test wires were, as nearly as we have been hitherto able to get them, equal and similar, and similarly mounted. Each test wire was 51 cm. of platinum wire of .006 cm. diameter and 12 ohms resistance, stretched straight between two metal terminals at the ends of a glass tube. One end of the platinum wire was soldered to a stiff solid brass mounting; the other was fixed to a fine spring carrying a light arm for multiplying the motion. The testing effect was the heat developed in the test wire by the discharge, as shown by its elongation, the amount of which was judged from a curve traced by the end of the multiplying arm, on sooted paper carried by a moving cylinder. Two of Lord Kelvin's vertical electrostatic voltmeters, suitable respectively for voltages of about 10,000 and 1,500, were kept constantly with their cases connected with the outer coatings of the Leyden, and their insulated plates with the inside coatings of the Leyden.

1. In the experiments hitherto made, the two wires to be tested have generally been of the same length. When they were of the same material, but of different diameters, the testing elongation showed, as was to be expected, that the test wire in the branch containing the thicker wire was more heated than the test wire in the other branch. In a continuation of the experiments we hope to compare hollow and tubular wires of the same external diameter, and same length and same material.

2. With wires of different non-magnetic material—for example, copper and platenoid—of the same length, but of very different diameters, so as to have the same resistances, the testing elongations were very nearly equal.

3. In one series of experiments the tested conductors were two bare copper wires, each .16 cm. diameter, 9 metres long, and resistance .085 ohm, which, it will be observed, is very small in comparison with the 12 ohms in each of the platinum test wires. One of the copper wires was coiled in a uniform helix of 40 turns on a glass tube of 7 cm. diameter. The length of the helix was 35 cm., and the distance from centre to centre of neighboring turns therefore ⅞ cm. The middle of the other copper wire was hung by sild thread from the ceiling, and the two halves passed down through the air to the points of junction in the circuit. The elongation of the test wire in this channel was more than twice as much as that of the test wire in the channel of which the helix was part.

4. One hundred and seventy-one varnished pieces of straight soft iron wire were placed within the glass tube, which was as many as it could take. This made the testing elongation 10 times as great as in the other channel.

5. The last comparison which we have made has been between iron wire and platinoid wire conductors. The length of each was 502.5 cm. The diameter of the iron wire was .034 cm., and its resistance 6.83 ohms. The diameter of the platinoid wire was .058 cm., and its resistance 6.82 ohms. Each of these wires was supported by a silk thread from the ceiling, attached to its middle (as in 3 and 4 for one of the tested conductors). Fourteen experiments were made, seven with the test wires interchanged relatively to the branches in which they were placed for the first seven. The following table shows the means of the results thus obtained, with details regarding the electrostatic capacities of the Leyden jars and the voltages concerned in the results.

In each case four Leyden jars, connected to make virtually one of capacity .02742 microfarad, were charged up to 9,000 volts, and discharged through divided channel. The energy, therefore, in the Leyden before discharge was 11.105×10^6 ergs. In each of the first three cases 1,450 volts were found remaining in the jars after discharge; in each of the last four 1,400.

Energy remaining in Leyden after discharge.	Energy used.	Elongation of testing wires in cms.			
		In channel containing platinoid.		In channel containing iron.	
			means.		means.
·29 × 10^6 ergs.	10·82 × 10^6 ergs.	01794	.01829	·01226	·01239
"	"	·01861		·01247	
"	"	·01832		·01244	
.27 × 10^6 ergs.	10·84 × 10^6 ergs.	·01823	.01836	·01276	·01261
"	"	·01828		·01280	
"	"	·01828		·01244	
"	"	·01865		·01244	

The mode of measuring the elongation of the test wires was, as may be understood from the preceding description, somewhat crude, but it is reassuring to see that the mean results in the cases of 10.82 and 10.84 megalergs of energy used are so nearly equal. The ratios for the two circuits are, in the two cases, respectively 1.48 and 1.46. The conclusion that the heating effect in the test wire in series with the platinoid wire is nearly one and a half times as great as that of the test wire in series with the iron is certainly interesting, not only in itself, but in relation to Prof. Oliver Lodge's exceedingly interesting and instructive experiments on alternative paths for the discharge of Leyden jars, described in his book on "Lightning Conductors and Lightning Guards," which were not decisive in showing any general superiority of copper over iron of the same steady ohmic resistance, but even showed, in some cases, a seeming superiority of the iron for efficiency in the discharge of a Leyden jar. Our result is quite such as might have been expected from experiments made eight years ago by Lord Rayleigh, and described in his paper "On the Self-Induction and Resistance of Compound Conductors."*

A Special Chronograph.†

BY HENRY LEA, M. INST. C. E., AND ROBERT BRAGGE.

In his capacity as electric inspector for the city of Birmingham, the duty of one of the writers is to test the accuracy of the electric meters used in that city. The test involves an accurate measurement on the one hand of the current of electricity passing through the meter, and on the other hand of the period of time during which the current of electricity effects a certain number of revolutions of the meter armature.

For the electrical measurements he selected a Crompton potentiometer, but as his chronograph was not accurate enough, he drew up a specification upon which the English Watch Company built the chronograph exhibited to the meeting. The ideal chronograph is one with a perfectly divided dial, an absolute prompt start, a definite stop at zero, and a continuous or running motion of the hand.

The test-room chronograph under notice is not intended for use as a watch; it is purely and simply a micrometer applied to time, and therefore it has only two pointers—one from the centre, giving seconds and their fractions, the other placed halfway between the centre and circumference, showing minutes up to sixty. The dial of aluminium being engine divided, is mechanically perfect; and being of large size, 2¼ inches of sight, the divisions of ten to the second are clearly defined.

The prompt absolute start is obtained by dispensing with all intermediate gearing, and relying on the main train of wheels impelled by the ordinary mainspring. The starting lever not only releases the balance wheel, but at the same time, by the momentary contact of a light spring blade, impels the wheel in the required direction.

The absolute stop at the end of an observation is obtained by the frictional contact of the aforesaid spring blade with the edge of the balance wheel.

The absolute stop at zero is obtained by fixing upon the axis of the seconds wheel a collet carrying a blade. Upon the top of the movement there is a lever which, during the period of an observation, is held back; but when the observation is concluded it is set free by the push of a button, and falls to a point where it crosses the path of the blade already referred to and stopping the wheels brings about the absolute stop we require.

The last thing requisite is for the seconds hand to have a continuous run. Everything tried up to the present has had a tendency to accelerate its rate, and is therefore inadmissable. The lever escapement has been adhered to, and by using hard-stone jewelings, and by observing great accuracy in the angles of the pallets, the makers are enabled to double the ordinary number of beats—36.000 instead of 18,000; and although in every beat there are three processes, the whole follows so smoothly that the progression of the hand is practically continuous.

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* Paper read before the Oxford meeting of the British Association.

* *Phil. Mag.*, Vol. XXII., 1886, p. 469.

†Paper read before the Oxford meeting of the British Association.

Preliminary Experiments to Find if Subtraction of Water from Air Electrifies It

BY LORD KELVIN, P. R. S., MAGNUS MACLEAN, M. A., F.R.S.E., AND ALEXANDER GALT, B.SC., F.R.S.E.[*]

Experiments with this object were commenced by one of us in December, 1868, but before any decisive result had been obtained circumstances rendered a postponement of the investigation necessary.

A glass U-tube with vertical branches, each 18 inches long and about 1 inch bore, with the upper eight inches of the branches carefully coated outside and inside with clean shellac varnish, was held fixed by an uninsulated support attached to the upper end of this branch. The other end was filled with little fragments of pumice soaked in strong pure sulphuric acid or in pure water; and a fine platinum wire, with one end touching the pumice, connected it to the insulated electrode of a quadrant electrometer. A metal cylinder, large enough to surround both branches of the U-tube without touching either, was placed so as to guard the tube from electric influences of surrounding bodies (of which the most disturbing is liable to be the woolen cloth sleeves of the experimenters or observers moving in the neighborhood). This metal tube was kept in metallic connection with the outside metal case of the quadrant electrometer. The length of the exposed platinum wire between the U-tube and the electrometer was so short that it did not need a metal screen to guard it against irregular influences. An indiarubber tube (metal metallically connected with the guard cylinder would have been better) from an ordinary blowpipe bellows was connected to the uninsulated end of the U-tube. Air was blown through it steadily for nearly an hour. With the sulphuric pumice in the other branch the electrometer rose in the course of three-quarters of an hour to about 9 volts positive. When the pumice was moistened with water, instead of sulphuric acid, no such effect was observed. The result of the first experiment proves decisively that the passage of the air through the U-tube gave positive electricity to the sulphuric acid, and therefore sent away the dried air with negative electricity. A corresponding experiment with fragments of chloride of calcium instead of sulphuric pumice gave a similar result. In repetition of the experiments, however, it has been noticed that the strong positive electrification of the U-tube seemed to commence somewhat suddenly when a gurgling sound, due to the bubbling of air through free liquid, whether sulphuric acid or chloride of calcium solution, in the bend of the U-tube, began to be heard. We intend to repeat the experiments with arrangements to prevent any bubbling of the air through liquid.

We have repeated our original experiment with pumice moistened with water in the insulated U-tube, and with an uninsulated U-tube filled with sulphuric pumice between the bellows and the insulated tube, so that the air entering it is artificially dried. With this arrangement the insulated U-tube was negatively electrified by the blowing of the air through it; but this electrification may have been due to the negative electrification of the dry entering air to be expected from the result of our first experiment. We intend to repeat the experiment with artificially dried and *dis-electrified* air blown through the U-tube containing pumice moistened with water.

DISCUSSION.[*]

A lively debate ensued, the main point of discussion being the validity of the method of experiment. Prof. Quincke, of Heidelberg, considered that the observed electrification might possibly be accounted for by the movement of the desiccating fluid in which the pumice was soaked. Prof. Lodge conceived that Lord Kelvin had attributed to condensation results which might be wholly accounted for by the friction of the air in its passage through the apparatus. Particles of dust carried over from the bellows would become electrified by friction against the indiarubber tube through which the current of air was forced; and the particles of moisture in the midst of the lumps of pumice might similarly be affected. Prof. J. J. Thomson threw doubts on the validity of experiments made with air rushing through tubes. Prof. Fitzgerald suggested that any electrification due to chemical action by the drying agent could be prevented by cooling the apparatus to a sufficiently low temperature. Prof. S. P. Thompson observed that if there was any doubt as to whether the evaporation of a substance caused its vapor to become electrified, that doubt ought to be dispelled by the fact that between the positive carbon and the vapor, in a voltaic arc, there was a pressure of some forty or fifty volts—a difference of potentials which could only be accounted for on the hypothesis of actual electrification by volatilization.

Prof. Schuster pointed out that in experiments of a highly complicated nature, like those with which Lord Kelvin and his colleagues had been dealing, the validity could only be established by a careful process of elimination, and this was exactly what Lord Kelvin and his colleagues had done. That the use of one drying agent alone, or only one form of the experiment, would warrant a doubt as to the validity of the conclusion was admitted by all; but the experimenters had been careful, by using various desiccating substances, and by varying the form of the experiment, to eliminate every one of the special marks of reasonable doubt, and had little or no doubt that the subtraction of water from air does electrify it. Lord Kelvin, in reply, said that Prof. Schuster was quite right.

Continuous Current Distribution of Electricity at High Voltage:

Being a Description of the Lighting of the City of Oxford.

BY THOMAS PARKER.[†]

The site determined upon for the central station is situated on the banks of the Isis, some 1,500 yards from the center of the area to be first lighted. This necessitated the use of a high-tension supply, and after due consideration, the high-tension continuous current system was preferred to the alternating, as giving the decided advantages of being able to supply the light day loads with batteries when the main generating station is shut down, and also of being able to use efficient motors. At the central station high-tension continuous currents are generated at an E. M. F. of 1,050 to 1,100 volts. The current is conveyed to a central switch station, situated in Broad street, by means of two pairs of cables, each having a sectional area of ·2 square inches. The insulation resistance is 3,000 megohms per statute mile; these cables are drawn into iron pipes. The cables are led to double-pole switches in the switch station, and by means of omnibus bars to the transformer boards. The current is taken through a resistance of about 40 ohms before leaving the station, and passes into the high-tension side of armature of the motor-generator, and excites the field by a few turns of series wire on the magnets. The brushes on both commutators are kept permanently down, and the machine begins to revolve as a motor, the shunt which is connected across the low-tension armature rapidly energizing the field magnets to the full saturation, so that the speed does not exceed the normal 550 revolutions. So soon as the machine is fully excited the high pressure primary current will have fallen to about $3\frac{1}{2}$ amperes, which is the actual in-put with no current on the secondary. The transformer is now running "light," and the secondary E. M. F. can be adjusted by means of the multiple contact switch and resistance coils above-mentioned. When this corresponds to the pressure at that time on the network, connection is made with the secondary armature and the mains. This is accomplished at the central switch station by momentarily opening and closing a small switch, which, short-circuiting the voltmeter, causes an increase of current to flow through a magnetic switch placed in the sub-station. The latter switch has its magnet coil always in circuit with the pilot voltmeter, the small current constantly passing being sufficient to affect the switch. When the voltmeter cable is short-circuited at the switch station, the resistance is so arranged that the full current required to operate the switch is allowed to pass through the wires, and causes the magnet to ascend and actuate switch to complete the circuit between the low tension armature and mains. On the switch at the switch station being again broken, the magnet drops and revolves a cam wheel to a position suitable for breaking the circuit, when the magnet is again energized from the switch station. The voltmeter now reads as before, having been only momentarily short-circuited, the one wire doing duty to voltmeter and operating the sub station. The E. M. F. on pilot voltmeter is kept constant by means of the regulating resistances in the primary circuit, as before explained. When the load has fallen again, which is indicated by the pilot voltmeter, the transformer is disconnected in a similar manner. First of all the resistance is inserted until the ammeter shows that no current is being supplied from the transformer to the network, then the switch short-circuiting the voltmeter is again made and broken, causing, as before, one-fourth of a revolution of the cam wheel, which this time allows a spring to pull out the contact piece which joins the transformer to the mains. As the switch is not, under ordinary circumstances, broken while there is current passing, there is no sparking at the brushes, and consequently the switch requires no attention. A cut-out arrangement is provided, so that in the event of too much current being supplied from the transformers to the mains, a magnet is raised, knocking the cam wheel round and breaking circuit, but leaving the switch ready to be worked again from the switch station. This cut-out also protects the transformer in event of the machine being placed on the circuit without the E. M. F. being properly adjusted, or in case a hot bearing should cause the transformer to pull up. Each transformer consists of an ordinary horseshoe magnet with a single armature, the secondary winding being placed on top of the primary, with a commutator at each end. The brushes are always left down, and as the action of the two windings neutralize each other, no alteration of load is required for change of load. The bearings are fitted with automatic oil pumps, which, drawing their supply of oil from a chamber contained in the dynamo pedestal, use the same oil again and again, and transformers have been working for a period of six months without changing the oil.

The low-tension distributing network consists of armored cables. The cables consist of two sizes, i. e., $\frac{1}{2}$-inch and $\frac{1}{4}$-inch section, and are laid in a trench under the footpaths, being provided with disconnecting branch boxes, so that any section or street can be cut out. Here again, owing to the use of continuous currents, a saving is effected, there being no loss due to induction, and a pair of steel armored flexible cables can be used. This makes a difference in the cost and trouble of connecting up new consumers; also as the cables themselves are flexible, a good deal of trouble and expense is saved when they are laid where gas and water pipes are found at varying depths beneath the footpaths. The high-tension feeders to the transformers are a similar class of cable to the trunk mains, being drawn into iron pipes. At the present time there are seven transformers in use and five sub-stations. At some sub-stations two transformers are used; it was thought advisable to keep to one standard size. At the switch station at Broad street there are installed two transformers and a battery capable of discharging at the rate of 120 amperes for eight hours. This battery will supply about one-twentieth of the load that the present station was designed for, and is capable of taking the load from about 1 o'clock in the morning until half an hour after sunset. The battery is charged by a small motor generator, which gives an output of 33 volts, 100 amperes, from the secondary armature, being supplied from the network at an E. M. F. of 103 volts on the primary. The 33 volts obtained from the secondary armature is put in series with the network, giving a total E. M. F. of 136 volts, which is sufficient to charge the cells; this may appear to be an inefficient method of charging cells, but only a small portion of the charging energy passes through the machine, and the total efficiency is 92·5 per cent.; this is more economical than charging from the network with a regulating resistance, besides saving the trouble of having to arrange the cells differently for charging and discharging.

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[*] Paper read before Section A at the Oxford Meeting of the British Association.

[*] For the above summary of the discussion of Lord Kelvin's paper we are indebted to "The Electrician" (London).

[†] Abstract of paper read before the Oxford Meeting of the British Association.

By the figures hereafter given it will be seen that, owing to the use of continuous currents and the contingent advantage of being able to shut down the station for such long periods, the Oxford system is in the front rank in adaptability and economy of working. The efficiency of the transformers varies from 87 per cent. at half load to 92 per cent. at full load, and as it should not be necessary to work a transformer with less than half load, the efficiency should not be less then 87 per cent. In actual practice at Oxford, as the consumers are somewhat scattered and few, it is necessary to run the transformers at less than half load during a portion of the time, which has somewhat reduced the efficiency. No doubt during the next few years the gaps in the district will be filled up, and then the all-round efficiency will be increased.

The figures for the year from July 1, 1893, to June 30, 1894, inclusive, show that the total efficiency of the system was 62·6 per cent., the Board of Trade units generated being 195,022, and the total units metered 122,081, of which 18,303 were supplied for public lighting. There were also an additional 2,019 units used at the switch station and sub stations. Out of the 195,022 units generated, 149,668 units were obtained from the secondary of the transformers, giving an all-round efficiency for the transformers of 76·7 per cent., which includes all losses in mains and resistances. Out of the 149,668 units supplied by the transformers, 114,721 units were supplied to consumers, and 34,948 units for charging the battery. The total number of units from the battery was 16,357, which makes he battery efficiency of the year 43.9 per cent. Adding the 16,357 units obtained from the battery to the 114,721 units obtained from the transormers, we get a total output of 131,077 units upplied to circuits. The total metered was 4,101, including those used at switch station, so that there remains 6,976 units unaccounted or, or not quite 5½ per cent.; as the current is supplied at 102 volts, and metered at 100, 2 per cent. is thus accounted for, and the rest is probably due to errors in instruments or observation of readings, these having been taken half-hourly throughout the year, the tendency being naturally to over-read rather than to under-read the instruments. The actual coal used during the 12 months was 6·43 lbs. per unit sold. During this period the cost of coal, which was best Welsh, averaged 21s. 10d. per ton, working out to .752d. per Board of Trade unit. The cost of coal increased during the coal strike and still remains high. In comparing this cost with that of other stations, due consideration must be given to the total output being only just over 100,000 units, whereas Newcastle and Bradford, which, I believe, are the only stations which spend less per unit on their coal, had a total output in 1893 of 360,000 and 480,000 units respectively.

Management and office expenses cost 1·534d. per unit, other running expenses 3·715d., making a total of 5·249d.

The revenue for the year for lighting was £3,715 8s. 2d., giving 10s. 11d. per 35 watt lamp installed, the number of units used being 18·2 per lamp throughout the year, and the average price obtained 7·3d. per unit.

The load factor at Oxford only works out to 5·93 per cent. By the expression "load factor" is meant the ratio of the units sold to the units that could be sold, with all the lamps always on, viz.:

$$\frac{\text{Meters watt-hours} \times 100.}{\text{Mean watts installed} \times \text{number of hours in the year.}}$$

A Graphical Transformer.

BY A. P. TROTTER.[*]

This instrument is intended for the expeditious replotting of a curve with transformed ordinates without calculation or scaling. It consists of a rectangular frame and a curved template or cam, and is used in conjunction with a straight ruler.

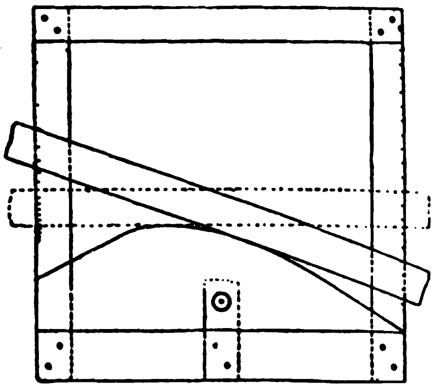
Let the scale of one system of ordinates be set off upwards along the edge of one of the perpendiculars, and the scale of the other along the edge of the other perpendicular, but downwards. Join the corresponding points on the scale by straight lines. The envelope of this system of lines may thus be drawn, and to this curve a cam is cut in thin wood or ebonite.

To transform any ordinate, set the frame against a T-square, adjusting the edge to the ordinate and the zero to the zero of the scale. Set a needle at the extremity of the ordinate; bring a straight edge to touch the needle and the cam; prick off a point at the intersection of the straight edge with the other edge of the frame. This point determines the length of the new ordinate.

The illustration represents an instrument provided with a logarithmic cam. With this instrument the product or quotient of two curves can be found by adding or subtracting the logarithms of the ordinates, or the logarithms of a series of observations can be plotted. Cams for other functions can be easily made; but it must be remembered that the action of the instrument is, as it were, arithmetical rather than geometrical, for a cam is useful only with reference to its own scale.

This instrument not only enables transformations of a definite and known character to be made, but is equally applicable for transforming in an empirical manner. The curve drawn by a recording voltmeter or ammeter may thus be replotted for estimation of area or other graphical analysis, without any knowledge of the law of the particular instrument. In other words, a correction can be applied to a curve.

The cams are easy to make, and even if carelessly cut cannot give rise to cumulative errors. It is convenient to use the upper edge of the ruler instead of the edge which rolls on the cam. The curve must in this case be set out with the ruler, and used with the same ruler or one of the same width. The rolling of a straight edge on a cam has been used in a photometer, invented by Mr. W. H. Preece and the author,[*] for the automatic calculation of the squares of the displacement of a lamp.



A GRAPHICAL TRANSFORMER.

Some Phenomena of Terrestrial Magnetism.

BY PROF. A. W. RUCKER, M. A., F. R. S.[†]

During the last ten years my friend Dr. Thorpe and I have been engaged upon a minute magnetic survey of the United Kingdom. The main conclusions at which we have arrived are about to be published, and I do not propose to recount them now. It is, however, impossible to give so long a time to a single research without having one's attention drawn to a number of points which require further investigation, and I shall perhaps be making the best use of this opportunity if I bring to your notice some matters in the practical and theoretical study of terrestrial magnetism which deserve a fuller consideration than has yet been given to them. In the first place, then, there is little doubt that the instruments at present used for measuring declination and horizontal force are affected with errors far greater than the error of observation. We employed four magnetometers by Elliott Bros., which were frequently compared with the standard instrument at Kew. These measurements proved that the instrumental differences which affect the accuracy of the declination and horizontal force measurements are from five to ten times as great as the error of a single field observation. The dip circle, which two generations ago was so untrustworthy, is, in our experience, the most satisfactory of the absolute instruments. In most cases these comparisons extended over several days, but the Astronomer Royal has described in his recent report observations made at Greenwich for two years and a half with two horizontal force instruments. These differ between themselves, and the discrepancy is of the same order of magnitude as those we have detected. If such differences exist between instruments of the Kew pattern, it is probable that they will be still greater when the magnetometers under investigation are of different types. This point has been investigated by Dr. Van Rijckevorsel, who five years ago visited Kew, Parc St. Maur, Wilhelmshaven and Utrecht, and, using his own instruments at each place, compared the values of the magnetic elements determined by himself with those deduced from the self-registering apparatus of the observatory. The discrepancies between the so-called standards which were thus brought to light were quite startling, and prove the necessity for an investigation as to their causes.

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[*] A paper read before the Oxford Meeting of the British Association.

[*] Proc. Inst. Civ. Eng., Vol. CX., p 81.

[†] Abstract of Presidential Address before the Mathematical and Physical Section, Oxford Meeting of the British Association.

Magneticians had long been aware that the instruments used by travellers should be compared at the beginning and end of a journey with those at some fixed observatory, to make sure that the comparatively rough usage to which they are subjected has not affected their indications. But Dr. Van Rijckevorsel's expedition first drew general attention to the fact that there are serious differences between the standard observatory instruments themselves. The importance of a careful comparison between them was at once recognized. The Magnetic Sub-Committee of the International Meteorological Conference held at Munich in the autumn of 1891, resolved that it is "necessary that the instruments employed for absolute measurements at the different observatories should be compared with each other and the results published." As far as I am aware nothing has been done to give effect to this resolution, but the necessity for such an international comparison is urgent.

The first point, therefore, to which I wish to draw the attention of the section is the necessity for a full primary comparison between the standard magnetic instruments in use at our different observatories. But if this were satisfactorily accomplished, the question would arise as to whether it should be repeated at regular intervals. We have at present only a presumption in favor of the view that the standards which we know are discordant are nevertheless constant.

This brings me to my next point, namely, that if we are to draw conclusions from the minor differences between measurements of secular or diurnal change made in the observatories, it is not only necessary that we should know whether the instruments are strictly comparable and constant, but the observations must be reduced by precisely the same methods. In 1886 the late Mr. Whipple drew the attention of the British Association to the fact that there was a systematic difference between the diurnal ranges of declination at Greenwich and Kew. His results were based on the three years 1870-72. In 1890 two of my students, Messrs. Robson and S. W. J. Smith, extended the comparison to three more recent years (1883-6-7), and obtained results in complete accord with those of Mr. Whipple. It is well known that the average daily oscillation of the magnet is affected by the magnetic weather. Sabine showed that magnetic storms do not merely buffet the needle now in this direction and now in that—they affect its average behavior, so that the mean swing east and west is different according as we deduce it only from days of magnetic calm or include those of storm. Mr. Whipple reduced the Kew observations by two methods,* one of which depended on the calmest days only, while the other included those which were moderately disturbed. Neither agreed exactly with the method in use at Greenwich, but the difference between the results deduced from them was so small when compared with the difference between either and that obtained at Greenwich, that it seemed possible that the diurnal variations, even at these closely neighboring places, might differ appreciably. The question whether this is so has now been answered. In 1890, at the request of the Kew Committee, the Astronomer Royal undertook to select early in each year five quiet days in each of the preceding twelve months. It was also agreed that, whether they adopted other methods or not, the chief English magnetic observatories should determine the diurnal variation from these days alone. The Greenwich and Kew observations for 1890 have therefore been worked up in exactly the same way, with the result that the discrepancy, which had persisted for twenty years, has entirely disappeared, and that the two diurnal ranges at the two observatories are now in as close accord as could be expected. If, therefore, we may judge from a single year, the cause of the difference lay in the choice of days.

The whole question of the cause of this phenomena has entered on a new stage. It has long been recognized that the earth is not a simple magnet, but that there are in each hemisphere one pole or point at which the dip needle is vertical and two foci of maximum intensity. A comparison of earlier with later magnetic observations led to the conclusion that one or both of the foci in each hemisphere is in motion, and that to this motion—however caused—the secular change in the values of the magnetic elements is due. The westerly march of the declination needle, which lasted in England up to 1818, and the easterly movement which has since replaced it, are connected with a supposed easterly motion of the Siberian focus, which, it is added, "there is some reason to believe . . . has recently been reversed." In opposition, therefore, to the idea of a rotation of a magnetic focus round the geographical poles which the earlier magneticians adopted, Stewart seems to have regarded the motion of the Siberian forces as oscillatory. A very different aspect is put upon the matter by a comparison of the magnetic maps of the world prepared by Sabine and Creak for the epochs 1840 and 1880 respectively. Captain Creak, having undertaken to report on the magnetic observations made during the voyage of the Challenger, supplemented them with the unrivalled wealth of recorded facts at the disposal of the Hydrographic Department of the Admiralty. He was thus able, by a comparison with Sabine's map, to trace the general course of the secular changes all over the world for forty years. The negative results may be shortly stated. There is no evidence of any motion either of magnetic pole or focus. The positive conclusions are still more curious. There are certain lines on the surface of the earth towards which in the interval under consideration the north pole of the needle was attracted. From each side the compass veered or backed towards them. Above them the north pole of dip needle moved steadily down. There are other lines from which, as tested by compass and dip circle, a north pole was in like manner repelled. The two principal points of increasing attraction are in China and near Cape Horn; the chief points of growing repulsion are in the north of Canada and the Gulf of Guinea. I am sure that my friend Captain Creak would be the first to urge that we should not generalize too hastily from this mode of presenting the facts, but there can be no doubt that they cannot be explained by any simple theory of a rotating or oscillating pair of poles. *Prima facie* they suggest that the secular change is due not so much to changes at the principal magnetic points as to the waxing and waning of the forces apparently exerted by secondary lines or points of attraction or repulsion. All down the west coast of America, close, be it noted, to one of the great lines of volcanic activity, north hemisphere magnetism has since 1840 been growing in relative importance. Near Cape Horn a weak embryonic pole is developing of the same kind as the well-known pole at the other end of the continent near Hudson's Bay. Along a line which joins Newfoundland to the Cape of Good Hope precisely the reverse facts have been experienced; while in the Gulf of Guinea a south hemisphere pole is growing within the tropics. Of course, I do not suggest that these secondary systems can ever determine the principal phenomena of terrestrial magnetism, or reverse the magnetic states of the hemispheres in which they occur. These are no doubt fixed by the rotation of the earth. I do, however, wish to emphasize the fact that they show that either secular change is due to the conjoint action of local causes or that if some single agent such as a current system within the earth, or a change of magnetic conditions outside it, be the primary cause, the effects of this cause are modified or complicated by local peculiarities. Mr. Henry Wilde has succeeded in representing with approximate accuracy the secular change at many points on the surface of the earth by placing two systems of currents within a globe, and imparting to the axis of one of them a motion of rotation about the polar axis of the earth. But he has had to supplement this comparatively simple arrangement by local features. He has coated the seas with thin sheet-iron. The ratio between the two currents which serves to depict the secular change near the meridian of Greenwich fails in the West Indies. Thus this ingenious attempt to imitate the secular change by a simple rotation of the magnetic pole supports the view that local peculiarities play a powerful part in modifying the action of a simple first cause, if such exist. I need hardly say that I think the proper attitude of mind on this difficult subject is that of suspended judgment, but there is no doubt that recent investigation has, at all events, definitely raised the question how far secular change is either due or modified by special magnetic features of different parts of the earth.

It is possible that light may be thrown upon this point by observations on a smaller scale. Assuming for the moment that the difference in the secular changes on opposite sides of the Atlantic is due to a difference of local causes, it is conceivable that similar causes, though less powerful and acting through smaller ranges, might produce similar though less obvious differences between places only a few miles apart. No fact connected with terrestrial magnetism is more certain than at present the rate of secular change of declination in this part of Europe increases as we go north. This is shown by a comparison of our survey with those of our predecessors fifty and thirty years ago, by M. Moureaux's results in France, and by Captain Creak's collation of previous observations.

The large number of observations at our disposal has enabled us to calculate the secular change in a new way, by taking the means of observations made about five years apart at numerous though not identical stations scattered over districts about 150 miles square. The result thus obtained should be free from mere local variations, but as calculated for the southeast of England for the five years 1886-91 it differs by nearly 5′ from the change actually observed at Kew. We have also determined the secular change at twenty-five stations by double sets of observations made as nearly as possible on the same spot at intervals of several years. The results must be interpreted with caution. In districts such as Scotland, where strong local disturbances are frequent, a change of a few yards in the position of the observer might introduce errors far larger than the fluctuations of secular change. But when all such cares are eliminated, when all allowance is made for the possible inaccuracy of field observations, there are outstanding variations which can hardly be due to anything but a real difference in the rate of change of the magnetic elements. We find, then, when we consider the earth as a whole, grave reason to question the old idea of a secular change caused by a magnetic pole or focus pursuing an orderly orbit around the geographical axis of the earth, or oscillating in some regular period in its neighborhood. It would, of course, be absurd to admit the possibility of change in the tropics and to deny that possibility in the arctic circle, but the new facts lead us to look upon the earth not as magnetically inert, but as itself—at the equator as well as the pole—producing or profoundly modifying the influences which give rise to secular change. And then, when we push our inquiry further, accumulating experience tells the same tale. The earth seems, as it were, alive with magnetic forces, be they due to electric currents or variations in the state of magnetized matter. We need not now consider the sudden jerks which disturb the diurnal sweep of the magnet, which are simultaneous at places far apart, and probably originate in causes outside our globe. But the slower secular change, of which the small part that has been observed has taken centuries to accomplish, is apparently also interfered with by some slower agency. the action of which is confined within narrow limits of space. Between Kew, Greenwich and Stonyhurst, between St. Leonards and Tunbridge Wells, and I may add between Mablethorpe and Lincoln. Enniskillen and Sligo. Charleville and Bantry, the measured differences of secular variation are so large as to suggest that we are dealing not with an unruffled tide of change, which, unaltered by its passage over continent or ocean, sweeps slowly around the earth, but with a current fed by local springs or impeded by local obstacles, furrowed on the surface by billows and eddies, from which the magnetician, if he will but study them, may learn much as to the position and meaning of the deeps and the shallows below. But if this is the view which the facts I have quoted suggest, much remains to be done before it can be finally accepted; and in the first place—to come back to the point from which I started—we want, for some years at all events, a systematic and repeated comparison of the standard instruments in use at the different observatories.

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* Sabine's and Wild's.

(*To be continued.*)

Elementary Theory of the Induction Alternating Motor.*

BY RANKIN KENNEDY.

I.

The present papers are attempts to give an explanation of the actions of the induction alternating motor without any mathematical illustrations. The explanation is based on a theory which is borne out by the actual facts ascertained by experiments with simple motors such as can be constructed for demonstration purposes.

Induction motors are of three kinds: single-phase, multiphase and transformer motors. The transformer motor is a special form of multiphase motor at present not embraced in this theory; we shall therefore refer only to the single-phase and multiphase induction motors.

It is a remarkable fact, now quite apparent to those who have followed the rise and progress of alternating motors, that if electricians had followed up the results of Arago's experiments with a rotating copper disk and a pivoted magnet, they would have discovered and developed the alternating motor and two-phase and three-phase motors years ago, but instead of following Arago's disk and elucidating the induction effects therein, we have followed Faraday's disk experiments, and so the continuous current motor and dynamo first arrived at comparative perfection.

Let us take a copper disk, C, mounted on a spindle, and free to rotate in front of a laminated horseshoe electro-magnet, M. As in Fig. 1, which is merely a diagram, in practice the disk should be mounted between two such magnets, for if mounted in front of one magnet excited by an alternating current, the disk would be violently repelled in a line parallel to the shaft; with two magnets it is balanced between them.

Imagine our magnet excited by an alternating current, then in the disk secondary currents are induced, circulating in front of the poles in lines concentric with the poles as seen in C, the front view of the disk in Fig. 1. Owing to the various lags between primary current and secondary current, these induced currents are really in the same direction as the current which induced them, but by the time they have reached full power the succeeding reversed current in the magnet coils has also reached full power, so that the magnetism actually repels these induced currents, but the repulsion is equally strong one way as the other tangentially, so that no rotative motion is set up. The induced current is quite as strong on one side of the pole as the other, but give the disk a smart twirl and at once off it starts and runs up to a considerable speed and exhibits power if a load is put on. How is this? Why does it run on after starting? The explanation is simple. Fig. 1, C, shows the induced currents circulating in the stationary disk, concentric with the poles, having no more tendency to move one way or the other.

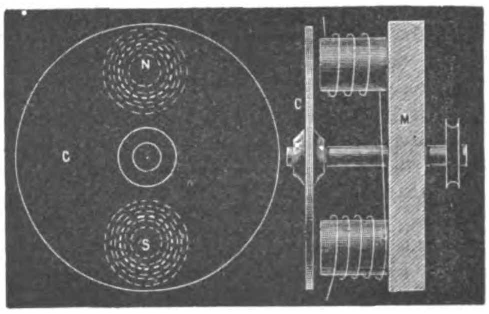

FIG. 1.

In Fig. 1A the disk has just been started in the direction of the arrows. Now the induced currents set up by the induction have been carried round by the motion during the interval of time between the induction and the formation of the induced current, so that when the next magnetic wave which repels the induced currents comes on these currents are flowing eccentric to the poles, as seen in Fig. 1A, and hence they are pushed much more forcibly one way than the other, and that in the direction of the motion given to the disk. It is this carrying round of the induced currents during the interval between the one + and the next − wave of magnetic flux, and vice versa, which causes the disk to go on rotating after once being set in motion; first we have a flow of + magnetism then after a short time a flow of current in the copper disk, but by this time the disk has moved round and a — flow of magnetism begins just in time to give the induced current its full impulse forward, then another flow of current after another short time appears in the disk to be acted on by the following + magnetic flow and so on, the currents keeping an eccentric position to the poles owing to the disk moving round while the currents are forming, and being eccentric, they are propelled more one way than the other.

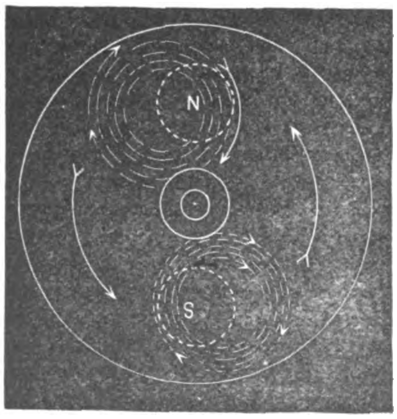

FIG. 1A.

It matters not which direction the turning impulse is given, the action is the same.

On this principle, the single-phase induction alternating motors of C. E. L. Brown and Elihu Thomson are built. They require to be started by some extraneous means; small motors may be spun round by hand, or by a string like a spinning top. Large motors are started as two-phase motors by splitting the current for a few moments.

A method of starting may be very instructively illustrated by the model here described, shown in Fig. 2. If between the disk, C, and the poles a piece of copper, shaped like that shown at S, S, be inserted, so as to half screen the poles, the disk will start off itself, because currents will now also be induced in the fixed copper blades which flow in the same direction and at the same time as those in the disk, so that the circular currents in the disk will cause the disk to turn in the endeavor to move under the fixed blades. It will be seen that the currents at *d d*, and *d' d'* flow in the same direction and are therefore attractive.

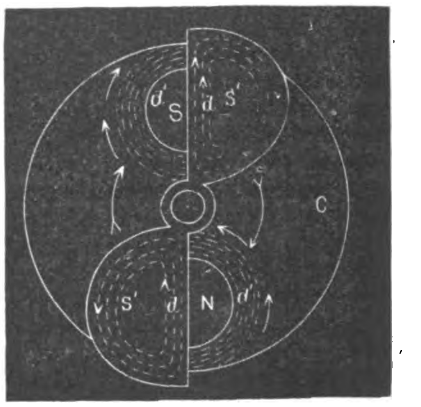

FIG. 2.

The copper blades are made movable so that they are only used at the start-up of the motor. In my next article the multiphase induction motor will be similarly treated.

An English View of the Trolley.

Verily, 'tis human nature to kick. In America the daily press inveighs against the "lightning speed" of the "deadly trolley." In England, at least in the town of Blackpool, they kick because the electric trams are too slow. Says the Blackpool *Herald:*

"The electric trams run very smoothly, but the pace of some of the cars is almost startling, so slow is it; and, as sure as fate, it is the slow tram you patronize when in a hurry to keep an appointment. The amateur minstrels cracked an excellent joke to the effect that the trams must be of divine conception, because 'the Lord made all creeping things!' I was reminded of this the other day, when I undertook a journey on one of the cars. I was much amused at the retort of the youthful conductor when an exasperated passenger complained of the snail-like progress we were making. 'Wot's the use of hurrying,' we were asked, 'when there's another slow 'un in front?' And a nervous old lady ventured to hope that the tram wouldn't run into anything! Whereat we all laughed, and the blush of shame rose upon the cheek of the conductor, hardened though the latter must be to such sarcastic remarks. But the unkindest cut of all was given by a well-known local clergyman; his patience having run out, he hailed a passing 'umble 'bus, and was quickly whirled to his destination."

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* From *The Electrical Review* (London).

Photo-Electric Researches of M. Auguste Righi.

BY DR. OLIVER LODGE.*

M. Righi has observed the following facts: (1) That ultra-violet rays reduce to sensibly the same potential two metals placed near each other (plate and gauze parallel and close); (2) That several photo-electric couples of this kind can form a battery; (3) That a simple metallic plate charges itself positively under the influence of radiation; (4) That a voltaic arc formed with a zinc rod gives the strongest effect, while the sun gives none.

Besides these facts he finds: (*a*) That certain gases and vapors, such as coal gas and CS_2, absorb the active rays strongly.

(*b*) That if the discharging body is easily movable it recedes like an electric windmill.

(*c*) A film of gypsum interposed between gauze and plate charges itself negatively on the side facing the negatively charged plate.

(*d*) Radiation produces its discharging effect even on non-conductors (ebonite and sulphur). With glass, resin and varnishes the action is feeble, or nearly nothing.

(*e*) If the experiment is made with a copper gauze and a zinc plate, the phenomenon nearly disappears on varnishing the gauze. His hypothesis is that radiation produces convection of negative electricity, the carriers being molecules of air.

(*f*) The carrying molecules move along the lines of force and throw electric shadows. To show this he varnishes a zinc cylinder, all except a generating line, charges it negatively to 1,000 volts with a dry pile, and places it parallel to a large earth-connected plane, which has a narrow rectangular portion insulated from the rest and communicating with an electrometer. Light only acts on the uncovered line of the cylinder, and on turning the cylinder round the electrometer is only deflected when it is exposed to some of the (circular) lines of force emanating from the active line of the cylinder.

(*g*) Radiation charges positively an insulated metal, even when it is an enclosure with walls of the same metal; the metal being certainly uncharged at the beginning of the experiment. The same occurs with sulphur and ebonite. If there is a feeble initial *plus* charge, radiation increases it.

(*h*) While the discharging power of radiation for negative electricity is strongest with zinc and aluminium, and slower with copper and gold, following the Volta series; the E. M. F. set up by radiation, when it charges things positively, is greatest with gold and carbon, and less with zinc and aluminium; again following the Volta series, but inversely.

(*i*) If radiation falls on an insulated metal plate connected with an electrometer, in an enclosure of the same metal, the positive electrification shown by the deflection of the electrometer is greater as the plate is further from the walls of the enclosure. The action stops when the metal has attained a certain electric density, constant for a given metal; so the potential of a plate is naturally higher as its capacity is less. It is thus established that radiation acts on the particles of gas in contact with a conductor; they go away with a negative charge, leaving *plus* on the conductor, until an electric density sufficient to balance this action is attained.

(*j*) It is probable that if the solar rays do not produce an effect it is because of the absorbing action of the atmosphere. In fact, if one places a tube whose ends are glazed with selenite between the sources of light and the metals being experimented on, the effects become sensibly stronger when the tube is exhausted.—*The Electrician.*

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*Comptus Rendus, Vol. CVII, p. 559.

ELECTRICAL NOMENCLATURE.

The following are the recommendations of the Committee of the Chicago Congress for symbols for physical quantities and abbreviations for units, as corrected by M. Hospitalier. The names of new units provisionally adopted by the A. I. E. E. appear in italics:

PHYSICAL QUANTITIES.	SYMBOLS.	DEFINING EQUATIONS.	DIMENSIONS OF THE PHYSICAL QUANTITIES.	NAMES OF THE C. G. S. UNITS.	ABBREVIATIONS OF THE NAMES OF THE C. G. S. UNITS.	PRACTICAL UNITS.	ABBREVIATIONS OF THE PRACTICAL UNITS.
Fundamental.							
LENGTH	L, l	....	L	Centimetre.	cm	Metre.	m
MASS	M	....	M	Mass of one gramme.	g	Mass of a kilogramme.	kg
TIME†	T, t	....	T	Second.	s	Minute ; hour.	m ; h
Geometric.							
SURFACE	S, s	$S = L.L$	L^2	Square centimetre.	cm^2	Square metre.	m^2
VOLUME	V	$V = L.L.L$	L^3	Cubic centimetre.	cm^3	Cubic metre.	m^3
ANGLE	α, β	$\alpha = \frac{\text{arc}}{\text{radius}}$	A number.	Radian.	....	Degree ; minute ; second ; grade.	
Mechanical.							
VELOCITY	v	$v = \frac{L}{T}$	LT^{-1}	Centimetre per second.	cm : s	Metre per second.	m : s
ANGULAR VELOCITY	ω	$\omega = \frac{v}{L}$	T^{-1}	Radian per second.	....	Revolutions (turns) per minute.	t : m
ACCELERATION	a	$a = \frac{v}{T}$	LT^{-2}	Centimetre per second per second.	$cm : s^2$	Metre per second per second.	$m : s^2$
FORCE	F, f	$F = Ma$	LMT^{-2}	Dyne.	dyne	Gramme ; kilogramme.	g ; kg
WORK	W	$W = FL$	L^2MT^{-2}	Erg.	erg	Kilogrammetre.	kgm
POWER	P	$P = \frac{W}{T}$	L^2MT^{-3}	Erg per second.	erg : s	Kilogrammetre per second.	kgm : s
PRESSURE	p	$p = \frac{F}{S}$	$L^{-1}MT^{-2}$	Dyne per square centimetre.	$dyne : cm^2$	Kilogram per square centimetre.	$kg : cm^2$
MOMENT OF INERTIA	K	$K = ML^2$	L^2M	Gramme-mass-centimetre-squared.	$g\text{-}cm^2$		
Magnetic.							
STRENGTH OF POLE	m	$F = \frac{m^2}{L^2}$	$L^{\frac{3}{2}}M^{\frac{1}{2}}T^{-1}$				
MAGNETIC MOMENT	$\mathfrak{M}$	$\mathfrak{M} = ml$	$L^{\frac{5}{2}}M^{\frac{1}{2}}T^{-1}$				
INTENSITY OF MAGNETIZATION	$\mathfrak{J}$	$\mathfrak{J} = \frac{\mathfrak{M}}{V}$	$L^{-\frac{1}{2}}M^{\frac{1}{2}}T^{-1}$				
FIELD INTENSITY	$\mathcal{H}$	$\mathcal{H} = \frac{F}{m}$	$L^{-\frac{1}{2}}M^{\frac{1}{2}}T^{-1}$	*Gauss.*	....	*Gauss.*	
FLUX OF (MAGNETIC) FORCE	Φ	$\Phi = \mathcal{H}S$	$L^{\frac{3}{2}}M^{\frac{1}{2}}T^{-1}$	*Weber.*	....	*Weber.*	
MAGNETIC INDUCTION	$\mathcal{B}$	$\mathcal{B} = \mu\mathcal{H}$	$L^{-\frac{1}{2}}M^{\frac{1}{2}}T^{-1}$	*Gauss.*	....	*Gauss.*	
MAGNETIZING FORCE‡	$\mathcal{H}$	$\mathcal{H} = \frac{4\pi NI}{L}$	$L^{-\frac{1}{2}}M^{\frac{1}{2}}T^{-1}$	*Gauss.*	....	*Gauss.*	
MAGNETOMOTIVE FORCE	$\mathcal{F}$	$\mathcal{F} = 4\pi NI$	$L^{\frac{1}{2}}M^{\frac{1}{2}}T^{-1}$	*Gilbert*	....	*Gilbert*; 1 *Gilbert* = 0.7958 ampère-turns (a–t).	
RELUCTANCE (MAGNETIC RESISTANCE)	$\mathcal{R}$	$\mathcal{R} = \nu\frac{L}{S}$	L^{-1}	*Oersted.*	....	*Oersted.*	
(MAGNETIC) PERMEABILITY	μ	$\mu = \frac{\mathcal{B}}{\mathcal{H}}$	A number.				
(MAGNETIC) SUSCEPTIBILITY	κ	$\kappa = \frac{\mathfrak{J}}{\mathcal{H}}$	A number.				
RELUCTIVITY (SPECIFIC MAGNETIC RESISTANCE)	ν	$\nu = \frac{1}{\mu}$	A number.				
Electromagnetic.							
RESISTANCE	R, r	$R = \frac{E}{I}$	LT^{-1}	....	....	Ohm.	ohm
ELECTROMOTIVE FORCE	E, e	$E = RI$	$L^{\frac{3}{2}}M^{\frac{1}{2}}T^{-2}$	....	....	Volt.	v
DIFFERENCE OF POTENTIAL	U, u	$U = RI$	$L^{\frac{3}{2}}M^{\frac{1}{2}}T^{-2}$	....	....	Volt.	v
INTENSITY OF CURRENT	I, i	$I = \frac{E}{R}$	$L^{\frac{1}{2}}M^{\frac{1}{2}}T^{-1}$	....	....	Ampère.	a
QUANTITY OF ELECTRICITY	Q, q	$Q = IT$	$L^{\frac{1}{2}}M^{\frac{1}{2}}$	....	....	Coulomb ; ampère-hour.	c ; a-h
CAPACITY	C, c	$C = \frac{Q}{E}$	$L^{-1}T^2$	....	....	Farad.	F
ELECTRIC ENERGY	W	$W = EIT$	L^2MT^{-2}	....	....	Joule ; watt-hour.	J ; w-h
ELECTRIC POWER	P	$P = EI$	L^2MT^{-3}	....	....	Watt ; kilowatt.	w
RESISTIVITY (SPECIFIC RESISTANCE)	ρ	$\rho = \frac{RS}{L}$	L^2T^{-1}	....	....	Ohm-centimetre.	ohm-cm
CONDUCTANCE	G, g	$G = \frac{1}{R}$	$L^{-1}T$	....	....	Mho.	mho
CONDUCTIVITY (SPECIFIC CONDUCTANCE)	γ	$\gamma = \frac{1}{\rho}$	$L^{-2}T$				
COEFFICIENT OF INDUCTION (INDUCTANCE)	L, l	$L = \frac{\Phi}{I}$	L	....	....	Henry.	H

† The International Bureau of Weights and Measures has established an important distinction in the notation of time, according as it refers to the *epoch* (date of time or day) or the *duration* of a phenomenon. In the former case the reference letters are used as indices, and in the latter they are on the same line with the numbers; for instance, an experiment began at $2^h\,15^m\,46^s$, lasted 2h. 15m. 46s., and ended at $4^h\,11^m\,12^s$. This method is to be recommended.

‡ N is the number of windings, and L the length of the solenoid generating the magnetizing force.

Current Items.

Among the benefits conferred upon the public by the much maligned trolley car not the least is the comfort it brings to many a domestic circle by quickening the home return of the weary toiler; but it remained for some suburban Bostonians to add another to its good points by using it as a solace for domestic loneliness. The Boston *Advertiser* states that "the married men who dwell near one another in a certain section of Cambridge, whose wives are away from home enjoying life at summer resorts, have recently contributed to the innocent gaiety of the classic city beyond the Charles by chartering an electric car and therein taking various summer evening excursions, with due accompaniment of song and laughter, not omitting appropriate banners and mottoes displayed for the delectation of an admiring public."

The Ameer of Afghanistan has had an electric light station erected at Cabul. It was built under the superintendence of Salter Pyne, an engineer in the employ of the Indian Government, who encountered many dangers and difficulties in the work. While at Cabul, besides the light station, he built by direction of the Ameer a large saw and planing mill, a mint, a cartridge factory, capable of turning out 16,000 rounds a day, an arsenal, where both breech and muzzle-loading rifles are made, gunpowder mills, a boot factory and, strange to say, a soap factory.

Personal.

Mr. A. B. Field, for several years with the General Electric Company as salesman, has resigned, and will hereafter be identified with the Iona Manufacturing Company, of 336 Congress street, Boston.

Mr. John F. Connor, of Chicago, is laid up temporarily with a scalded leg, having stepped in a hot water well while at work.

Mr. Chas. P. Shain, who met with a serious accident to one of his legs several weeks ago, has gone to Atlantic City to recuperate.

Mr. E. G. Bernard, of Troy, was in New York last week for a few days.

The Electrical and Street Railway Reporter.

This journal, which we had commenced to think was not going to reappear, comes out again in its own gorgeous hue—the last number bearing the dates June July. It will be remembered that this journal had gotten behind in its issues. The present number announces an entire change of management—Messrs. Gilbert G. McDuff and Newton Hall stepping out, and Messrs. T. B. Ferguson as president, A. St. Clair as vice-president, and W. H. Doolittle as secretary and treasurer, taking their places, with Mr. St. Clair as editor. These gentlemen are all old newspaper men and the promise held out by their first issue will doubtless be fulfilled in those which follow. There is nothing like putting a newspaper man at the head of a newspaper. We welcome these gentlemen to the field of trade journalism and feel sure they will meet with the success that they deserve.

Will Toronto Be the Next?

It is reported from Toronto that the city has specifications in preparation for a municipal lighting plant, and that bids will be advertised for within the next few weeks.

There are two companies there at present, one arc and one incandescent, and both giving good service.

The General Electric Company could not bid upon incandescent apparatus for a city plant.

The Curtis Company Quits.

The Curtis Electric Company, builders of street railway motors, have closed their factory in Jersey City for an indefinite period. This is the third shut-down in the brief history of the company, and it is now believed the works will not reopen.

The low price of railway apparatus has rendered it impossible for any but the large companies to make any money.

The Detroit Fight—Chapter 967.

Once again the city of Detroit is stirred up over the contracts for the municipal plant.

It is now charged that $4,500 was spent among the Aldermen to secure the recent confirmation of the Brush lamp contract, and the contract will be reconsidered by the Council before it is finally signed.

Mr. S. M. Hamill, in a letter to President Beck, denies any wrong-doing on the part of his company and says, with proper modesty, nothing but the eloquence of himself and Mr. Douglass secured the confirmation.

ELECTRICITY sees no reason to change its original opinion, expressed some months ago, that the Detroit Electric Light and Power Company and the Fort Wayne interests will yet come out on top.

More Telephone Competition.

The organization of the Clamond Telephone Company has been nearly completed at Philadelphia. The company, it is said, will have ample capital and will be at once an important factor in the business.

The Clamond outfit, while new to this country, has been in use in Europe for several years. In France there is a similar company, known as the Home Telephone Company, over whose wires conversation has been held for a distance of 1,500 miles.

The officers of the company are: President, C. Hartman Kuhn, ex-president of the American District Telegraph Company; secretary and treasurer, J. Andres Harris, assistant secretary of the Girard Life and Trust Company; general manager, Samuel Bell, Jr.; Board of Directors, D. 3. Newhall, S. F. Houston, Rodman E. Griscom, John Hampton Barnes, William Hacker, George Burnham, Jr., E. Cooper Shapley and F. S. Lewis.

The company has temporary offices in the Girard Building.

The Peterson Conduit Company.

The Peterson Electric Conduit Railway Construction Company has been incorporated at Milwaukee by A. E. Smith, William Meyst and H. Samuel Esch. The company will manufacture underground electric conduits under the patents issued to H. Peterson, whose patents have attracted considerable attention from electric railroad men. The system was described in ELECTRICITY several months ago.

Queen & Co.

The creditors of Queen & Co. have decided to grant an extension of three years, in the hope of thus getting their claims in full, as suggested by the management. If at any time the business shows an actual loss the creditors may then cancel their extension agreement and have a receiver appointed to wind up the company's affairs.

The debts are about $200.000, with bills receivable and book accounts of about $80,000.

It is difficult to see how the concern can succeed with the same management under which it has failed.

Bids Wanted.

Sealed proposals in duplicate will be received at the Bureau of Yards and Docks, Navy Department, Washington, until 1 o'clock P. M. on Saturday, September 8, 1894, for an electric lighting plant for the League Island Navy Yard, Philadelphia. Specifications and blank forms of proposals will be furnished, and plans of the Yard may be examined upon application to the Commandant of the League Island Navy Yard or the Bureau. A bond for the sum of $2,000 must accompany bids for the work.

Canadian Notes.

Some time ago the Toronto Railway Company placed an order with the Siemens & Halske Electric Company of Chicago for two 1,000 H. P. generators for their new power-house. The machines were finished and loaded upon freight cars ready for shipment when the works caught fire and the two machines were destroyed along with the company's buildings. The street railway company has now contracted with the General Electric Company of Peterboro to supply one of the big generators, which is to be ready by September 15.

It is understood that the Grand Trunk Railway Company has under consideration the conversion of its belt line about the city of Toronto into an electric system with a greatly improved service of cars. The company believe that by doing so the service can be improved and the working expenses reduced nearly one-half.

The city of Toronto's proportion of street railway receipts for July amounted to $7,142.18, which represents receipts for the month of $89,277. For July last year the city's share was $6,654.13, on receipts of $83,176.

The Department of Inland Revenue, Ottawa, is engaged, under authority of two acts passed by Parliament last session, in organizing the electrical inspection branch. Controller Wood is corresponding with Prof. Loudon, president of Toronto University, in reference to the proper modes of procedure. The Canadian experiment in this connection will be closely watched, as, although England and the United States have established standards of electrical units and measurements, neither of these countries has so far taken up the work of inspection.

The London Street Railway Company have commenced relaying their tracks.

At a recent meeting of the Hamilton Board of Works it was decided to renew the contract with the Hamilton Electric Light Company for street lighting for one year. The company is to be paid 28 cents a light per night, the usual reduction to be made for lamps out.

A company of Winnipeg and Rat Portage capitalists have a scheme on hand for developing water power at the latter place and transmitting it as far as Winnipeg, 110 miles.

An action of $50,000 has been taken out by the Montmorency Electric Power Company against the Royal Electric Company of Montreal.

General News.

What is Going on in the Electrical World.

Henry, Ill.—The plant of the Henry Electric Company was destroyed by fire on the 20th inst.; loss, $10,000. The company will rebuild.

Kensington, Md.—The route of the Chevy Chase and Kensington Electric Railway has been fixed, and construction work will begin at once.

Springfield, Ill.—The lighting contract between the city and the Springfield Electric Light and Power Company has been annulled by the city council.

Columbiana, O.—Mayor Bell has issued a proclamation calling for a special election to decide on issuing $10,000 of bonds to construct an electric light plant.

Egg Harbor City, N. J.—The prospects are that the city will enter into arrangements shortly for the building of a $20,000 waterworks and electric light plant.

Hartford, Conn.—The Hartford, Manchester and Rockville Tramway Company has filed a certificate of acceptance of the charter granted to it by the Legislature.

Lincoln, Neb.—The council has been petitioned by a number of property owners to take steps to secure an electric light plant to be owned and operated by the city.

Pawnee City, Neb.—The people here have voted to bond the city for $4,000 and buy the electric light plant, enlarge its capacity and run it in connection with the waterworks.

St. Louis.—John L. Black, of this city, is said to have discovered a way of getting rid of the electric spark when the live current is opened or broke. He has patented the device.

Los Angeles, Cal.—It is confidently expected that electric cars will be running from Los Angeles to Garvanza by the 1st of September and to Pasadena before the 1st of January.

Iowa Falls, Iowa.—The council has passed an ordinance granting a franchise for twenty years to E. B Hellman & Co. to furnish electric light and power to the inhabitants of this city.

Rockville, Conn.—The Rockville and Ellington Street Railway Company have sent a petition to Mayor Henry asking for the right of way for an electric road through the streets of this city.

Plainfield, N. J.—The line of the Plainfield Electric Railway is about to be extended to Dunellen and to Netherwood, agreement between the company and the council having been reached.

Philadelphia.—In the educational classes of the Pennsylvania Railroad Department of the Y. M. C. A. during the coming school session two new studies will be taken up—telegraphy and electricity.

Youngstown, O.—The Yale & Towne Manufacturing Company of Stamford, Conn., are arranging to remove their electric crane department to this city, the board of commerce having made a flattering offer.

Indianapolis, Ind.—The Indiana Electric Railway Company has placed on record at Goshen a mortgage for $500,000 in favor of the Knickerbocker Trust Company of New York, the money to be used in extending the street-car service.

Rome, N. Y.—The lamp committee, not satisfied with the bids recently offered for electric lighting, reported the fact to the city council, and that body has instructed the chamberlain to advertise for new bids for one, three and six years' lighting.

Chattanooga, Tenn.—Major J. H. Warner, the owner of Catoosa Springs, intends to build an electric road from Catoosa station on the Western and Atlantic Railroad direct to the springs. The water power obtainable from Tiger Creek will be utilized to operate the dynamos.

Ambler, Pa.—The borough council has granted a franchise of the principal streets of the borough to the Ambler Electric Railway Company for their line, which is to extend from Hammonville to Ambler, a distance of five miles. Mr. Shepp, of Philadelphia, is one of the owners of the line.

Summit, N. J.—The township committee has granted a franchise for the establishment and operation of an electric light and power plant to

Jonathan Bonnel, George V. Muchmore, Frank E. Dana, Charles A. Robbins and W. E. Rundle. It is stipulated that the plant shall be erected and in operation within a year.

Pittsburg, Pa—The *Times* says: "If the Glenwood and Dravosburg Electric Railway Company can purchase the franchise of the Dravosburg company, a line will be built connecting Dravosburg and Elizabeth. This will connect Pittsburg and Elizabeth and make the longest electric railway in the country."

Faribault, Minn.—The council has granted a franchise to James Hunter & Co., proprietors of the Polar Star Mills Electric Light and Power Company, for street ligh ing. As the Faribault Consolidated Gas and Electric Company had been previously granted an exclusive franchise by council, a legal contest is likely to occur.

Green Bay, Wis.—The Fort Howard common council has passed an ordinance granting David McCartney, a Fort Howard banker, a franchise for the construction of an electric street railway. Construction of the railway must begin within ninety days. The system will be independent of Green Bay's, but they will probably be connected.

New York.—The new surface railroad on Lenox avenue will be operated in part by electricity instead of cable power. The Siemens & Halske system of underground electric power will probably be used. From Twenty-third street to Seventy-seventh cable power will be applied. From Seventy-seventh street to the Harlem River electricity will be the motive power.

Toledo, O.—The contract for the extension of the Maumee electric railway, making a belt line between Perrysburg, Maumee and Toledo, has been signed by I. E. Knisely and Dr. Clark, as trustee, for all the necessary private right of way. Burton P. Foster, son of the president of the company, Parks Foster, who has gone to Europe, will superintend the construction and take entire charge of the road's management.

Syracuse, N. Y.—The Syracuse, Eastwood Heights and De Witt Electric Railroad Company has been granted an extension of its franchise by the city council. The company is at present in the hands of a receiver (Charles G. Baldwin) and a question has arisen as to whether the franchise may be turned over to him. If that is done, it is said Mr. Baldwin would have to treat the franchise as an asset, and in time sell it to a third party.

Hempstead, N. Y.—The trustees of this village have ordered the Ball Electric Light Company to remove its poles from the village streets under the penalty of having them removed by the highway commissioner at the expense of the company. The company has, it is understood, refused to fulfil its contract for street lighting for which it gave a bond of $3,000. The trustees will advertise for bids for lighting the streets with electricity.

Bridgeport, Conn.—It is probable that the American Patent Car Truck Company will select Bridgeport as the location for their works. The company were recently incorporated for the purpose of manufacturing an electric-car truck for which they hold the patent. The officers are Wm. H. Stevenson, of Bridgeport, president; John B. Waring, of Newark, N. J., vice-president; W. S. Stevenson, of Bridgeport, secretary and treasurer.

Boston.—Negotiations are now in progress providing for the consolidation of the Automatic Fire Alarm and Extinguisher Company Limited and the United States Electric Fire Signal Company, both of this city. The companies will be merged into what is to be known as the Automatic Fire Alarm Company, a new concern, organized lately at Portland under the Maine law, with a capital stock of $250,000. E. S. Cowles, of New York, has been elected president, B. W. Wells treasurer, and Charles Burgher secretary.

Allegheny, Pa.—Mrs. Johanna James of this city has entered suit against the city for $2,000 for the destruction of a "dear old oak" whose branches extended over the roof of her house and gave shade and beauty to the premises. While stringing electric light wires the workmen caused several to be placed over Mrs. James' property and through the branches, bringing them in contact with them. When the electric current was conducted through the wires it was communicated into the tree, causing its complete destruction.

Rochester, N. Y.—An official test of the automatic cutout for fire alarm and patrol boxes recently patented by Louis W. Miller and adopted for use in the patrol boxes of the city, was made a few days ago by City Electrician Barnes and other officials. A current of 500 volts, or twenty times as much pressure as a box would be subjected to under any ordinary circumstances, was sent through the box, and after the test there was no evidence that the mechanism of the box had been harmed in the least. The test was accordingly pronounced a success.

Chicago.—The Northwestern Electric Light and Power Company has made an assignment in favor of William L. Abbott as assignee. Assets are estimated a' $66,450 and liabilities $66,866.79. The corporation was organized in 1892 with a capital stock of $100,000 for the purpose of supplying electric light and power to private consumers. The president is F. W. Bryson.—The wave of atmospheric electricity which reached here on the night of the 19th was the most severe for many years. The wires serving the South and East from Chicago were rendered nearly useless, and it was almost impossible to get any news from New York and other cities.

Jersey City, N.J.—The Curtis Electric Works in Lafayette has closed down indefinitely. This is the third time the Curtis Works has suspended.—Thomas S. Crane, a resident of East Orange, is developing an invention which he thinks is destined to effect a revolution in the maritime world. It is nothing less than the electroplating of the entire hull of steel or iron ships with copper. A company is now erecting a plant in Jersey City where a full sized vessel will be plated. It is believed that electroplating will prevent the fouling of the ship's hull with barnacles, and the cost of applying the plating is said to be less than the cost of docking and cleaning a vessel when she becomes fouled with barnacles.

Kansas City, Mo.—At the recent meeting in this city of the executive committee of the board of directors of the Harrison Telephone Company of Chicago, all the members were present except Mr. Elkins. Mr. Egan, ex-U S. Minister to Chili, a member of the committee, stated to a local reporter that the business conducted at the meeting was principally of a routine nature. "The company," said he, "is in a flourishing condition. We have our system at work in a great many cities throughout the country and are doing a thriving business at every point. The oldest plant is at Fort Smith, Ark., which we are about to replace with a new and larger one. At Decatur, Ill., our plant is operating 600 telephones and one of a similar capacity is being put in at Topeka."

Saginaw, Mich.—The "culm bank" idea, recently presented in the columns of ELECTRICITY in a comparison of the cost of water power and coal waste in the generation of electricity for transmission, appears to have found acceptance elsewhere than in the colliery section of Pennsylvania. A Saginaw paper says: "Considerable outside attention is being given to the coal fields of Saginaw County, and a gentleman from Bay City while in the board of trade the other evening, said that it was perfectly feasible to establish a large electrical plant at the mines, using the slack coal for fuel, and furnish light to the valley cities at a very low figure. The electric plant would also furnish the power to transport the cars loaded with coal to the coal docks on the river for shipment by boat."

The Book of the Fair.

One of the most satisfactory records of all the wonders of the Great Fair is the work entitled "The Book of the Fair," issued in monthly parts by the Bancroft Company of Chicago. The study of such a stupendous collection is of itself a liberal education. Thousands of surprising creations and curiosities—the telautograph and other marvellous developments of electricity, the latest mechanical devices, the ethnological treasures from all the most noted collections, the display of the nations in the Liberal Arts Building, the statuary from Italy, the gold and silversmiths' exhibits from London, the Tiffany gems, the Swiss wood-carving, the Bohemian glass from Austria, the French bronzes, the German porcelain, Japanese vases, the great telescope and countless others; the Horticultural Building, with the rare ferns, cacti, fruits and flowers from every land; the United States Government display; the model postal car, Mint, models from the Patent Office, the historic relics, the life size soldiery from the Puritan to the staff officer of to-day; the Fisheries, with its monster aquarium and interesting exhibits; the Palace of Fine Arts, with its seventy-two galleries of statuary and paintings; the foreign buildings, teeming with interesting, strange and curious collections illustrative of the customs, habits, resources and arts of people of other lands; the State buildings; the Midway, its cosmopolitan life and features; the Mines Building, with the greatest mineral display every brought together, the coal pyramid, the diamond mines of South Africa, and the great Strumm exhibit; the Agricultural Building, illustrating the agricultural resources of the nations of the world; the Krupp pavilion; the Transportation Building, showing the methods of transportation from the earliest period to the present time, the original Grace Darling boat, the sectional steamship, the Nicaragua Canal model, the great 999 engine, the mammoth locomotive "Lord of the Isles"; the Woman's Building, with the Queen of Italy's laces, the French salon, the colonial exhibits, the examples of woman's work in all countries. "The Book of the Fair" includes 2,500 copperplate engravings and 1,000 beautiful pages; it is published in twenty-five parts at $1 each.

California and the Pacific Coast.

A golden opportunity is offered to parties intending to visit California. Rates are lower than usual, and a weekly tourist car line over the West Shore Railroad, under the management of Messrs. A. Phillips & Co., makes the trip at this time one of economy and pleasure.

COMMERCIAL PARAGRAPHS.

Mr. E. Nashold, of 934 Monadnock Building, Chicago, has invented a self-locking cleat which appears to offer several advantages over those at present on the market. They are reasonable in price and worth a trial by dealers.

The Mather Electric Company of Manchester, Conn., are now represented on the Pacific Coast by the following contractors for their apparatus: H. B. Gregory & Co., Portland, Ore.; the Will & Finck Co., San Francisco, Cal.; the Machinery Supply Co., Los Angeles, Cal.

The Beacon Lamp Company.

The Beacon Vacuum Pump and Electrical Company of Boston, makers of the well-known Beacon Incandescent Lamp, are prosecuting their business with vigor and meeting with flattering success. Their lamps are making friends wherever used and are well worth the consideration of buyers for the fall trade. The company maintains branch offices as follows:

New York—In charge of J. T. Hambay and E. S. Kaliske, brother of Manager H. S. Kaliske; Philadelphia—H. A. Truitt, former treasurer and manager of the Cheltenham Electric Light Company; Chicago—T. C. Rafferty & Co.

Excelsior Apparatus in the West.

Mr. R. J. Randolph, Western agent of the Excelsior Electric Company, Monadnock Building, Chicago, has made the following sales recently:

St. Louis Light and Power Company, St. Louis, Mo., three 100-light dynamos, 2,000 C. P.; Mercantile Library Association, same place, two 50-light dynamos, 2,000 C. P.; Danville Gas, Electric Light and Street Railroad Company, Danville, Ill., one 100-light dynamo; Oakland Gas and Electric Light Company, Oakland, Cal., one 100-light dynamo, 2,000 C. P.

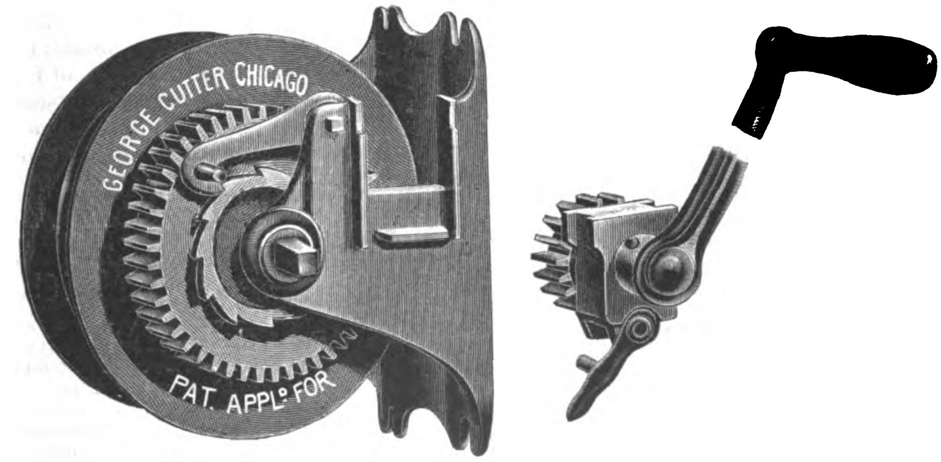
Dickson Engines for the New York Edison Station.

The Dickson Manufacturing Company of Scranton, Pa., has recently shipped another of the complement of engines which the company is furnishing to the Edison Electric Illuminating Company of New York. This engine is of 600 horse power triple expansion type.

The Dickson Company has up to date built for the New York Edison Company engines of 1,000, 1,200 and 2,500 horse-power which are regarded by experts as the highest type of engine manufacture.

Cutter's Combination Windlass.

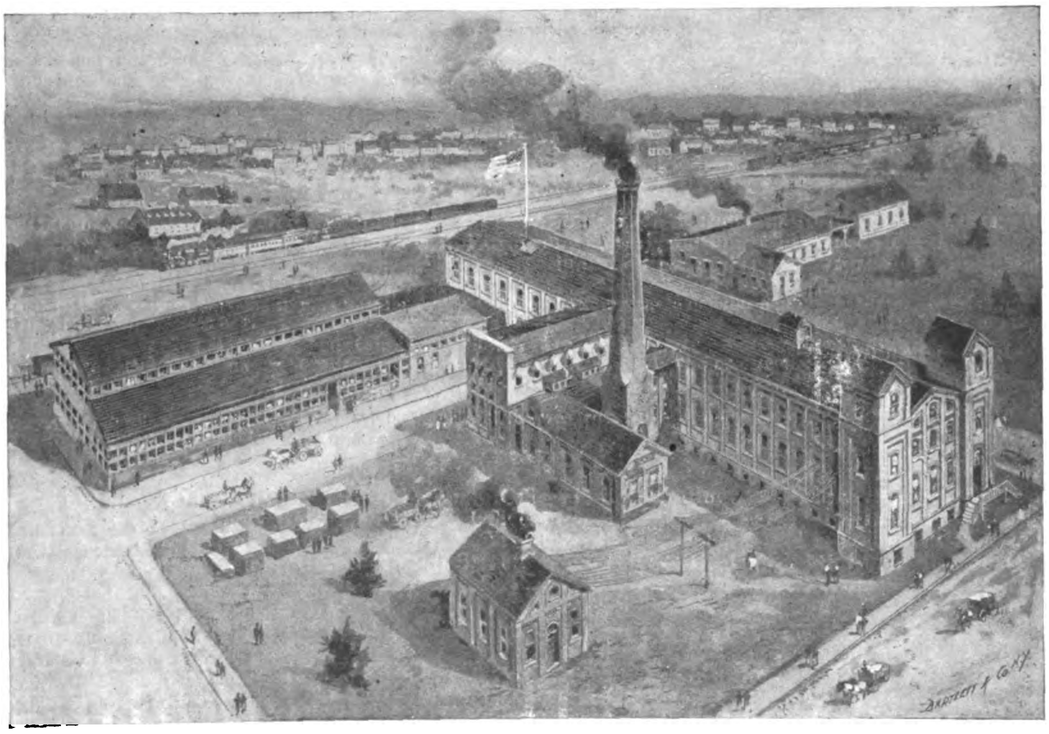
The gain in leverage makes a geared windlass popular with trimmers for raising lamps, but the difference in cost over that of a plain windlass has counted against a more widespread use of the former. The extra price being due to the cost of the gearing, the only feasible way of reducing it would consist in making one pinion do for a score or more of the devices. This is what Mr. Cutter has done in his new form, which consists of a geared windlass with a detachable pinion, the latter, together with its bearing-box, being secured to the portable handle. The bearing-box fits into a recess in the windlass frame and is easily locked in place by the hinged catch, thus making a geared device. What is more, the pinion itself is hollowed out to fit the shaft of the hoisting drum, so that the same handle will do in using the device as a plain windlass.



The pinion handle with the bearing-box is made as light as possible, so as to be easily carried by the trimmer, the result being a practical geared windlass at a price within the reach of plant owners. Other details and the general make-up of the device can be seen from the accompanying cut, which was loaned by the maker, Mr. George Cutter, of Chicago.

The Mather Electric Company.

The plant of the Mather Electric Company, covering a number of acres, is situated in Manchester, Conn. (three hours on the train from either New York or Boston), directly on the main line of the New York and New England Railroad, which, together with a spur track running directly into their erecting shop, allows them to load heavy generators directly on the cars and gives them the best of facilities. They have recently completed an extension to their plant in the form of an iron building 300 x 50 feet, for an erecting shop, constructed by the well-known Berlin Iron Bridge Company of East Berlin, Conn., and fitted with a fifty-ton Shaw electric travelling crane, which, together with a large amount of new machinery which the Mather Company has recently installed, consisting of heavy planers, boring mills, radial drills, lathes, etc., enables them to handle large generators up to 500 kilowatts and larger in capacity. The Mather Electric Company are making a specialty of both belted and direct connected work, especially for railway and power purposes. Their facilities for testing generators, from the smallest to the largest, under most severe conditions, are second to none, their steam plant being especially arranged and adapted for this purpose. The Mather Company already contemplate another extensive addition to their plant in the early future, to accommodate large work, and new battery boilers and engines, especially for testing this class of apparatus. The entire plant of the Mather Company is operated by electric motors, sizes varying from five to fifty horse power, which system of transmission and sub-division of power they have found exceedingly satisfactory and economical in the operation of their works.



MATHER ELECTRIC COMPANY'S WORKS, MANCHESTER, CONN.

INCORPORATIONS.

The Fairfax Company, Chicago, Ill.—to maintain and operate a hotel or apartment building or both, and to furnish the light and heat for same. Capital stock, $40,000. Promoters: Wm. Brace, Edw. S. Elliott, Henry A. Ritter.

The Acme Electric Company, St. Louis, Mo.—to manufacture and deal in electrical supplies and apparatus of all kinds and do a general electrical business. Capital stock, $3,000. Promoters: E. T. Goodberlet, Jno. A. Goodberlet, L. E. Goodberlet, St. Louis.

The Ziegler Electric Company, Boston, Mass.—to manufacture, purchase and sell college supplies, electrical and mechanical instruments, machinery and apparatus. Capital stock, $25,000. Promoters: A. Arthur Ziegler, Alfred Ziegler, J. Oscar Ziegler, Jno. L. Gebhardt, Geo. Sauer, Boston, Mass.

The Camden Power and Light Company, Camden, Ark.—to purchase, own and operate electric plants and sell light and motive power to the citizens of the town. Capital stock, $10,000. Promoters: Chas. L. Vickers, Wm. K. Ramsey, Jas. S. Cummins.

The Montgomery Electric Light and Power Company, Montgomery, Ill.—to furnish electric light, heat and power, etc. Capital stock, $10,000. Promoters: Lysander Hord, Jr., Jno. G. Habermeyer, Wm. C. Weise.

The Atchison Railway, Electric Light and Power Company, Atchison, Kan.—to do a general electrical business and build an electric railway in Atchison. Cpaital stock, $300,000. Directors: H. A. Odell, George W. Riggs and A. E. Cullingworth, of Chicago, and W. P. Waggener, Ellsworth Ingalls, C. C. Hetherington and S. E. Harburger, of Atchison.

The Scott Electric Lamp Company—to manufacture electric lamps and other electrical apparatus in New York City. Capital stock, $25,000. Directors: Richard Outcault and Edward M. Brown, of New York City; Bertram H. Herbert, of Hoboken, N. J.; Falconbridge Plante, of Brooklyn, and Palmer Brown, of Woonsocket, R. I.

The Lockport City and Olcott Electric Railroad Company—to construct an electric road twenty miles long from Lockport, N. Y., to Olcott, Lake Ontario. Capital stock, $20,000. Directors: William T. Holly, M. E. Stone, Adrian G. Funck, Jacob L. Toch, Edward J. Cunningham, Thomas J. Agnew, Noel Gale, George E. Dunscombe and F. Eugene Crasson, of New York City.

The Jacksonville Electric and Power Company, Jacksonville, Ill. Capital stock, $100,000. Incorporators: George D. Stafford, Samuel H. Trude and William H. Lee.

The Viscosity Oil Company, Chicago, Ill.—to manufacture and deal in lubricating oils and greases and general steam and electric supplies. Capital stock, $10,000. Promoters: S. A. Johnson, Wm. H. Little, James H. Poare.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED AUGUST 21, 1894.

ELECTRIC RAILROADS AND APPLIANCES.

524,758. Electrical Railway Signal. Lawrence Dornberger, Highland Falls, N. Y. Filed April 17, 1894.
524,773. Electric-Railway Supply System. Malone Wheless, Washington, D. C. Filed July 7, 1894.
524,785. Controller for Electric Cars. Marion B. Monroe, New Orleans, La. Filed Feb. 28, 1894.
524,823. Electric-Railway Car. John C. Henry, Westfield, N. J. Filed Aug. 27, 1892.
524,883. Fender for Trolley or Other Cars. Elmer Bockman and Joseph E. Hagan, Philadelphia, Pa. Filed Feb. 21, 1894.
524,961. Street-Railway Motor. William H. H. Stineman, Hick's Mill, assignor of one-half to Edward I. Clark, Baltimore, Md. Filed Feb. 23, 1894.
524,976. Electric-Railway Supply System. James F. Cummings, Detroit, Mich., assignor of one-half to Eugene M. Engelman, Milwaukee, Wis. Filed Sept. 22, 1892. Renewed Jan. 17, 1894.

ELECTRIC LIGHTS AND APPLIANCES.

524,706. Electric-Light Support. William H. Connell, Wilmington, Del. Filed Jan. 24, 1894.
524,707. Electric-Lamp Holder. Fay O. Farwell, Dubuque, Iowa, assignor of one-half to the Adams Company, same place. Filed March 6, 1894.
524,981. Electric-Arc Lamp. Rudolf H. Jahr, Opladen, Germany, assignor of one-half to Carl Ferdinand Schoeller, same place. Filed April 19, 1894.
524,983. Apparatus for Supplying Electricity for Light and Power Purposes. Milton M. Kohn, Chicago, Ill., assignor to himself and Siegfried M. Fischer, same place. Filed Sept. 24, 1891. Renewed Feb. 17, 1894.

MOTORS, DYNAMOS, ETC.

524,845. Automatic Regulator for Dynamos. Henry D. Symmes, St. Catharines, Canada. Filed June 6, 1894.
524,852. Motor-Generator. John C. Henry, Westfield, N.J. Original application filed Dec. 18, 1891. Divided and this application filed Jan. 28, 1893.
524,884. Commutator for Dynamo-Electric Machines. Geo. F. Card, Covington, Ky., assignor to the Card Equipment Company, Mansfield, Ohio. Filed Jan. 8, 1894.
524,911. Apparatus for Transforming Continuous Electric Currents into Alternating Currents. Franz S. F. Schneider, Fulda, Germany. Filed March 20, 1894.

TELEPHONE AND TELEGRAPH APPARATUS.

524,711. Printing-Telegraph. Robert A. Fowden, Philadelphia, Pa., assignor to the Fowden Printing Telegraph Company, Trenton, N. J. Filed Dec. 22, 1893.
524,925. Coin Controlled Telphone Apparatus. Byron C. Wolverton, Elmira, N. Y., assignor to the New York and Pennsylvania Telephone and Telegraph Company. Filed May 12, 1894.

MISCELLANEOUS.

524,708. Non-Conducting Handle. Fay O. Farwell, Dubuque, Iowa, assignor of one-half to the Adams Company, same place. Filed June 7, 1894.
524,710. Method of Producing Electrodes. Desmond G. Fitz-Gerald, London, England. Filed Nov. 7, 1893.
524,717. Safety-Switch for High-Potential Circuits. Samuel Harris, Cleveland, Ohio. Filed June 14, 1894.
524,749. System of Electrical Distribution. George Westinghouse, Jr., Pittsburg, Pa. Filed June 16, 1890.
524,789. Electrical Subway System. John C. Reilly, Brooklyn, N. Y. Filed May 28, 1894.
524,793. Commutator-Cylinder. Alton J. Shaw, Muskegon, Mich. Filed June 7, 1894.
524,808. Circuit-Controller. Edward J. McEvoy, New York, N. Y. Filed July 7, 1894.
524,843. Separator for Battery-Plates. William L. Silvey, Dayton, Ohio. Filed Feb. 12, 1894.
524,844. Electrical Testing-Switch. Henry Smith, Buffalo, N. Y. Filed March 29, 1894.
524,850. Insulator. Charles N. Hammond, Boston, Mass. Filed Dec. 18, 1893.
524,881. Electric Heater. Tapley W. Young, Washington, D. C., assignor to David R. McKee, trustee, same place. Filed Oct. 6, 1893.
524,940. Tank or Cell for Electrolytic Purposes. Francis E. Elmore and Alexander S. Elmore, Leeds, assignors to the Elmore's American and Canadian Patent Copper Depositing Company, Limited, London, England. Filed Nov. 25, 1892.
524,947. Electric Danger-Signal for Railways. Archibald B. Murray, San Rafael, assignor of one-half to James W. Moyle, San Francisco, Cal. Filed March 17, 1893.
524,953. Electric Meter. Carl D. Raab, Kaiserslautern, Germany. Filed Jan. 18, 1894.
524,973. Fire-Alarm System. Joel W. White, Providence, R. I., assignor of one-half to Ashbel T. Wall and Geo. A. Wall. Filed May 28, 1894.
524,977. Underground Conduit for Electrical Conductors. James. F. Cummings, Detroit, Mich., assignor of one-half to Eugene M. Engelman, Milwaukee, Wis. Filed Jan. 17, 1893. Renewed Jan. 17, 1894.
524,980. Electric Wire Coupling. Charles K. Hall and William B. Lillard, New Orleans, La.; said Lillard assignor to said Hall. Filed Dec. 8, 1893.

ELECTRICITY.

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EDITORIAL NOTES.

Variation of Terrestrial Magnetism. The causes of the secular variations of terrestrial magnetism, which was the subject of Prof. Rucker's inaugural address before the British Association, present a problem which is as interesting and important as its solution is difficult. The local magnetic changes which were at first attributed to the rotation or other movement of the points of maximum intensity in each hemisphere must probably be explained in some other way, as the most reliable evidence of recent years goes to show that there has been no motion of these magnetic poles, which are probably fixed by the motion of the earth. On this hypothesis the secular variations are due less to the variations of the main magnetic poles of the earth than to secondary lines or points of attraction or repulsion, which vary in different degrees in different localities. The explanation of these secondary systems may be found in local physical and electrical conditions within the earth, or the magnetic conditions outside the earth, or, more probably, a combination of both.

As the secular changes in terrestrial magnetism are closely related to the causes of local magnetic disturbances, Prof. Rucker suggests that a study of the latter may be useful in solving the problem of secular variations. Earth currents and the presence of magnetic materials have been suggested as the causes of local disturbances, and both causes are probably to be found in different localities.

The nature of the magnetic material is also a question to be determined, as well as the way in which it is magnetized. From the fact that all large masses of magnetic rock that affect the magnetic needle from a distance always attract the same pole, it is argued that the magnetism is more likely to result from induction from the earth than from earth currents, as in the latter case the current must always flow in the same direction around all these masses in one hemisphere and all in the opposite direction in the other hemisphere, for which there seems to be no apparent explanation. Variations in temperature and pressure affecting the permeability of the magnetic materials in the earth also enter the question of local magnetic disturbances. The whole subject is as yet largely a matter of speculation, and it involves so many modifying conditions that its solution, if possible, must be a very distant attainment.

* * *

Storage Battery Litigation. The victory which the Chloride Accumulator people have just won over the Consolidated Electric Storage Company is a matter of great importance to the former, but of infinitely greater importance to the trade at large.

Every one interested in the real progress of the art will feel a sense of relief that the Consolidated Company has at last been disarmed and its power to blackmail and bulldoze taken away.

The disgraceful conduct of this company has often been referred to by us and is a matter of common knowledge. They became the owners by purchase of the Brush patents. These patents were sustained by the courts, and no doubt properly so. If the Consolidated Company had then gone ahead and demonstrated their ability to construct a practical commercial cell, and given to the trade the benefit thereof even at a high price, there could have been little criticism. This they did not do.

They have never turned out anything of value. In fact it is plain truth that they have scarcely been recognized as being in the battery business at all. They have used their patents as a club to keep out other workers in the field, and have endeavored to blackmail not only intending manufacturers but purchasers of other batteries. They have been a stumbling-block in the path of progress, and something worse.

They have feared the Chloride Company since its organization in 1888, knowing that they were working on correct lines and that the company were well backed financially. They only brought suit for alleged infringement when actually forced to do so by Mr. W. W. Gibbs, the president of the Chloride Company. The publication of Mr. Gibbs's correspondence with Mr. Bracken of the Consolidated Company left the latter no other course.

Application for a preliminary injunction was accordingly made. The validity of the Consolidated Company's patents was not questioned by the defendants, who simply claimed no infringement. This claim has been fully upheld by Judge Green, in a decision reprinted elsewhere.

The American public is to be congratulated on this changed condition of affairs. Central station men can now avail themselves of an accumulator system on a par with the best made abroad, and without any fear of troublesome litigation at the hands of Mr. Bracken and his misguided company.

* * *

The Atlanta Convention. There is every reason to expect that the Convention of the American Street Railway Association at Atlanta in October will be one of the most successful which this body has held.

The business revival will be under way in another month, and the exceptional facilities offered to exhibitors will no doubt be the means of securing a first-class display of apparatus.

Every man in the country interested in railway work ought to go in some way. For Eastern men two routes of travel are practicable, one by the Pennsylvania system, the other by the Norfolk and Western. The latter, through Mr. L. J. Ellis of this city, has arranged a special train, with first-class appointments in every detail, to carry the delegates and their friends from New York to Atlanta and return. This route offers the only really pleasant ride between the two cities, traversing a charming section of the country. On the return trip tourists are offered the opportunity of visiting some of the most picturesque spots in the South and many of historic interest.

Beyond the fact that the Norfolk and Western is by far the best route, electrical men will not forget the treatment received at the hands of the Pennsylvania Company at the time of the St. Louis Convention. A special train was arranged and paid for, the company's agent agreeing to furnish the best cars and service which the Pennsylvania equipment afforded. When the train was on track in Jersey City it was seen that instead of this they had furnished the shabbiest Pullman cars in use anywhere on the system; the service was abominable, the dining-car having few attractions even for a very hungry man.

It is now a proper time to show the Pennsylvania Company that their unfair treatment at that time was resented and not forgotten.

Delegates from the interior, as far west as Buffalo or Pittsburg, will have a much more enjoyable trip if they come to New York and make the Atlanta trip on the special train with the New York and New England party.

* * *

Conflicting Electrical Systems. The legal rights of the various electrical systems now in commercial use have not yet been fully established in this country, for the reason, perhaps, that until recently no serious injury has resulted to the telephone or telegraph systems through the introduction of lighting or railway currents of high voltages. In England, we believe, the once disputed points are now regarded as settled in favor of the rights of the transportation systems.

Mr. R. D. Fisher contributes to ELECTRICITY this week a summary of the decisions so far rendered here, which will be of value to those interested in this subject. While no one of the decisions is of such a nature as to be regarded as conclusive, it is evident that our courts lean towards the view that the more delicate systems must look out for themselves, and protect their systems at their own expense from the possible damages resulting from the use of high voltages in the same districts.

The vital question, however, is that in regard to electrolysis, an evil effect of the railway systems which has not been understood at all until very lately, and the extent of which, we believe, is scarcely comprehended as yet. The destructive agent is at work in all our large cities, and sooner or later there must come a conflict between the railway companies standing alone on one side and the telephone, gas and water companies and the municipalities themselves arrayed in common interest on the other.

There are no decisions, so far as we know, on which to base a prophecy as to the view the courts will take of this matter. Will they mulct the railway companies for the immense damages inflicted upon the other companies, or will they simply insist on the former putting an end to the evil, regardless of the cost to themselves?

One thing is certain, water and gas mains can not be insulated to protect them from the electric currents; and it is equally certain that the underground plant of many companies is today undergoing slow but sure destruction.

Does not ordinary business sense demand that the railroad companies do all in their power, regardless of cost for copper, to stop the leakage of return currents before the damage has increased further?

* * *

IN our view of the situation of the General Electric Company, and our estimate of the number of months which they could continue in business, we have always given them credit for doing from \$2,500,000 to \$3,000,000 of business a year in small supplies, which we supposed yielded them a good percentage of profit. Now we learn that this branch of their business shows an actual loss of over \$100,000 for the last six months. If this is a fact, and we assume that it is because Mr. J. P. Ord, the controller of the company, has admitted it, the last prop has gone, and there is absolutely nothing left to justify a continuation of the business. Mr. Sunny's office shows a falling off in its supply business of 80 per cent. The Denver and San Francisco offices are doing a total in all lines of less than \$15,000 per month. Nothing of consequence is being done at Cincinnati or Atlanta, and Mr. Hughes in New York has little to do except make affidavits. Wall Street may think as it pleases, but the collapse cannot be much longer delayed.

* * *

NO TRAVELER can fail to take notice, when in Philadelphia, of the splendid service of the Philadelphia Traction Company, which had such a hard fight to secure the privilege of changing to the trolley system. This company's plant and equipment are to-day the best in this or any other country, and their service is beyond criticism. The thoroughness of the station equipment is shown by the fact that there are over 500 Weston instruments in use on the switchboards. Every citizen of Philadelphia who opposed the admission of the trolley should be compelled to stand on William Penn's hat brim in the public buildings court and make public apology or be debarred from riding on anything else than a horse-car or a Broad street stage for the rest of his days. The Westinghouse Company can easily "point with pride" to the working of its apparatus, and the Traction Company should be regarded as public benefactors.

* * *

Is the electric light regarded in England as an illuminant to be used only by the rich or moderately well off, and not by the very poor? The query is suggested by the following: "At a recent meeting of the St. Pancras Vestry a member complained that a costermonger, who held auctions on Saturday night in Kentish Town Road, was using electric light. He asked whether a man who paid neither rates nor taxes was entitled to the electric light. Although this seems an absurd point to raise, it involves a nice legal question, for the costermonger buys his light from a tradesman who, in turn, purchases it from the vestry." We do not know the plan upon which the St. Pancras Vestry conducts its business, but in our land of the free and home of the brave any man, whether a fruit peddler, a scavenger, or a railroad president can have electric light if he pays the price.

* * *

THE Philadelphia Edison Company has made more progress than any other Edison local company in establishing its so-called "rights." This would be commendable if it had been fairly done, if the methods employed had been honorable. But we fear they were not. The first concern to grant the claim for past damages was Drexel & Co. This was followed by a surrender on the part of the infringing companies which were owned largely by the same people who control the Edison Company. Acting upon this the campaign has proceeded to outsiders, who were shown what Drexel & Co. and the others had done. This smacks too much of collusiveness and trickery to merit respect.

* * *

A FEW weeks ago we recorded the status of a rate war between the street railway companies of Savannah, Ga. The fare was reduced to one cent, and we expressed our opinion that the law of the survival of the richest operated in Savannah as elsewhere. Now we learn that application has been made for a receiver for the Electric Railway Company.

* * *

MR. E. I. GARFIELD has drawn first blood for the Ft. Wayne Corporation in New England, having sold a 3,000-light alternator and two 60-light arc machines. We guess Uncle Ellery will get there.

IT will be noted by readers of one of our news items this week that Harold P. Brown still lives, and moreover that he is still posing as an expert electrician, with only the river between him and New York City. We hope his present employment necessitates less swearing than he was accustomed to when the subject of electrocution was before the people of this State.

* * *

STRANGE things happen in the General Electric Company and strange thoughts agitate the brains of the employes. The latest news is that Mr. S. D. Greene expects to be president of the company some day.

Voluntary Receivership for H. Ward Leonard & Co.

H. Ward Leonard & Co. have voluntarily gone into the hands of a temporary receiver. H. Ward Leonard has been appointed temporary receiver for New York State, where the most important assets of the company are located. The receivership was the result of a friendly suit brought by the Interior Conduit and Insulation Company at the request of H. Ward Leonard & Co., and the bill shows assets amounting to about $177,000, and liabilities amounting to about $62,000; $109,000 of these assets have been locked up in a suit against the Cayadutta Electric Railway Company for over a year past and are likely to be for several months to come.

H. Ward Leonard & Co. being a foreign corporation and subject to attachment the directors deemed it best for the interests of the creditors and stockholders to place the affairs of the company in the hands of a receiver until the settlement of this suit when, it is claimed, there will be, not only ample assets to settle all claims in full, but abundant means for the stockholders to resume business with.

A New Two-Phase Transmission Plant.

The Stanley Electric Manufacturing Company have recently made a contract with the Montmorency Electric Power Company of Quebec for furnishing them with three 675 H. P. two phase A. C. generators which will be used for conveying the water power of the famous Montmorency Falls to the City of Quebec for light and power purposes. The Fall altogether is over 300 feet, there being one perpendicular fall 268 feet. For the past ten years this water power has been used for supplying light in Quebec, the present plant consisting of three 2,000 light A.C. machines made by the Royal Electric Company, Montreal, and fifteen arc light machines with a total capacity of 600 lamps. These present A.C. machines are of course single phase and they are runnnig them 1,800 volts at the Falls and delivering 1,000 volts at Quebec, simply supplying ordinary lighting service. The three new machines will generate a potential of 5,500 volts; the output of each machine will be carried on four wires to a sub-station in Quebec where step-down transformers will reduce it to 2,000 volts, and the distributing system through the town will be at this potential. The drop in the line between the Fall and the sub-station will be 6 per cent. One thousand K. W. capacity of step-down transformers for this purpose will be placed in a sub-station, with arrangements for keeping the transformers cool by air blasts. The current will be used for lighting, general power distribution by two phase A. C. motors and for running the street railway by use of rotating transformers.

The progressiveness of the Montmorency Company and its success are largely due to the able management of Mr. Badger, its general superintendent.

CONFLICTING ELECTRICAL SYSTEMS.

Their Legal Status Not Fully Determined—The Trend of Decisions So Far Rendered.

BY R. D. FISHER.

It is always interesting and instructive to observe the course pursued by the courts toward new inventions and note their application of old principles of law to new conditions. In order to serve the new uses that have been found for it, the legal status of the electric current in its numerous applications is being gradually established It is apparent, however, from a review of the cases wherein the conflicting rights of the purveyors of electricity have so far been contested that the legal status has not yet been definitely settled by the courts. It is probable that the ultimate settlement, at least so far as interference of currents is at stake, will be made through the ingenuity of inventors rather than by the intervention of courts It is quite clear from the trend of decisions that economy and public convenience will demand that electricity shall be crowned "King of Powers" and some way be found to give it a clear right of way. In the meantime it is the duty of courts to protect existing property, systems or patents from unnecessary or wanton injury or illegal supersedure.

It is the purpose of this article to present, for convenient reference, a summary of the decisions so far rendered which can properly be regarded as precedents in the future.

AUTHORITY TO USE ELECTRICITY.

It is well settled that the use of streets belongs to the public at large, that the Legislature represents the public, and that a municipality has no further control over its streets than that given to it by the Legislature, either expressed by charter or by implication. (See 35 N. J. L., 208, and 6 Whart., 25.)

From this basis it follows that the authority of a local government over its streets or highways depends entirely upon the charter derived by legislative enactment. (See Dill Mun. Corp., sec. 680.) It is equally as well settled that a city has not the power to grant an exclusive franchise or permanent privilege to an electric company. Legislatures alone have, unless limited by constitutional restraint, a right to grant to an electrical company an exclusive, indefinite and irrevocable franchise for the use of the streets, if made in explicit language. (Elliott on Streets, 332; Gas Co. vs. Light Co., 115 U. S., 650.) Indeed it has been held in many cases that a city has no right to grant an exclusive right even for a stipulated or limited time. (Electric Co. vs. Edson, etc., Co., 33 Fed. Rep., 659.)

ELECTRIC WIRES—INTERFERENCE.

This is a subject that is destined to become more important with respect to the use of electric currents for different purposes, because of a growing demand that an indefinite number of wires shall no longer be strung over the streets, but instead all must be placed in subways.

The development in the art has led to numerous legal controversies between the new and the old concerning respective rights. The primitive possessors naturally resented the intrusion and damaging contact of the modern and more powerful currents necessary for light and traffic purposes. On this point there has been much litigation and considerable conflict of decisions. The operators of the more delicate plants insist on being protected against the use of the more powerful currents which impair their service and the value of their plants. This claim is based on the ground of primitive authority and occupation, and they allege that by right they are not legally bound to adopt new and expensive devices and inventions as a neutralizing protection against the effects of the newcomers.

The first legal contest took place between the electric light companies and the telephone companies. Courts all over the country were appealed to for writs of injunction, but before many of them came to trial on their merits it was found that inventive genius had bridged the difficulty before a final decision was had. The first court, however, to lean toward "protection" was that of the Supreme Court of Nebraska. In the case of Tel. Co. vs. Elec. Light Co., 17 Neb., 284, it was held that electric light wires should be kept at a certain distance from the telephone wires on streets already occupied by the latter.

This decision was soon followed by a ruling by the highest court of Ohio, in which it was decreed that an electric light company stringing wires no nearer than four feet from existing parallel wires would not be enjoined, on the ground that the evidence of experts tended to show that no sensible induction would take place at that distance. (See Tel. Co. vs. Elec. Light Co., 14 Cin. Weekly Bulletin, 227.)

The more serious phase of the question has arisen in the alleged interference by electric railway systems. In the latter case it is necessary that the battle of legal rights should be fought to a finish as soon as possible. There are a number of decisions on this subject, all of which have been rendered within the past three years, and while there is some conflict, the weight of authority is favorable to the electric railway interest, holding, impliedly at least, that the more powerful current has simply been applied to the purposes of transportation by street railways which have long occupied the streets for a purpose paramount to all others, and therefore had a stronger and earlier claim of right to use the streets than the electric interests constructed for light and sound. Among the earlier cases considered was that of Tel. Co. vs. Elec. Ry. Co et al., C. P. C., Ohio, Jan., 1889. An injunction was sought to restrain the operation of an electric railway by single trolley without a return wire. The court not being satisfied from the proofs that the return wire would relieve the difficulty refused to order the railway company to adopt the device, and thus denied the prayer for injunction. A similar ruling was had on the strength of evidence concerning a device, alleged to be a success as a conductive precaution, in the Chancery Court of Hamilton County, Tennessee. (Tel. Co. vs. Elec. Ry. Co., June, 1889.) A favorable decision to the Telephone Company was had in the case of Same vs. Ry. Co., in the District Court of Sedgwick County, Kansas, June, 1889. In the more recent cases, namely: Tel. Co. vs. Ry. Co., Third Judicial District Court of Utah; Tel. Co. vs. Ry Co., C. C. of Eau Claire, Wis.; Tel. Co. vs. Ry. Co., 9 N. Y. Supp., 177; Tel. Co. vs. Ry. Co., Chancery Court of Knox County, Tennessee; and finally the United States Court, in case of Tel. Co. vs. Elec. Ry. Co. (42 Fed. Rep., 273), universally hold that it is competent to readjust the occupancy of streets so as to afford mutual protection if possible. The grant to each company to use the invisible energies of nature should perhaps carry with it neutralizing restraints so as to reduce to a minimum the injurious effects of their contact or interference; but in the event of failure of this equitable view, it is apparent that courts have grave doubts whether any successful cause of action or remedy for the alleged injury is in sight for the more delicate systems except through a readjustment of methods and construction to meet the new conditions. The streets are held in trust for the people for primary purposes of travel, and any other purpose inconsistent with this right will meet with legal rebuke. In conclusion, it is evident that the contest for supremacy in the electrical field is impliedly settled in favor of the more powerful current so long as used for transportation purposes, and that the settlement of interferences must ultimately be made by and through the ingenuity of inventors rather than by repeated resorts to courts of law.

VICTORY FOR THE CHLORIDE CELLS.

A Preliminary Injunction Refused.

Judge Green, in the United States Circuit Court at Trenton, has handed down his decision refusing to grant a preliminary injunction against the Electric Storage Battery Company, manufacturers of chloride cells, in the suits brought by the Consolidated Electric Storage Company under the Brush patents.

Following is an abstract of Judge Green's opinion :

Two reasons conjointly compel a denial of the motion for a preliminary injunction made by the complainants.

Equity peremptorily insists that such action (a preliminary injunction), so drastic in its effects, shall be taken only in those cases wherein a clear, unclouded, equitable right to the interference of the Court is shown; in all other cases the demand is to be met by refusal. Otherwise unfair prejudgment may result.

In the case at the bar the proof of infringement fails to attain to this standard. It is quite true that, on the part of the complainants, certain gentlemen, most eminent in their profession, and whose opinions as experts are entitled to great weight, have not hesitated, in their affidavits presented to the Court upon this motion, to assert quite positively that not only the storage battery manufactured by the defendants, but as well the process used in the manufacture, do without doubt infringe some if not almost all of the claims of the letters patent under consideration.

Giving full weight to the opinions of these witnesses, elucidated and most eloquently enforced upon the attention of the Court in the exceedingly able argument of counsel, it still remains to be said that the defendants have, in opposition thereto, presented opinions of other scientists, equally as learned and of equal standing and repute in the scientific world, which are directly antagonistic thereto, and by which they most distinctly and positively declare that in their judgment neither the process pursued by the defendants nor the completely manufactured battery infringes in the slightest particular upon those secured to the complainants by their letters patent. And so upon one side are found the concurring opinions of Prof. Morton and Prof. Chandler, Prof. Houston and Dr. Barker ; upon the other, those of Prof. Brackett, Prof. Cross, Prof. Thomson and Mr. Van Size. These are gentlemen of unquestioned veracity ; thoroughly understanding the subject matter under consideration ; stating opinions with confidence which they believe to be well formed ; and yet they arrive at conclusions which are irreconcilably and diametrically opposed. It must be apparent that affidavits of this character, *ex parte* as they are, can only be productive of doubt. When the statements so made and the opinions so expressed come to be tested by a severe and thorough cross examination, beyond question those which show themselves securely founded upon reason and fact will be immediately accepted and concurred in. But until then the existence of a doubt, well founded and reasonable, as to the right of the complainants to the remedy they ask, cannot be overlooked.

The existence of such doubt must now at least control the action of the Court.

There is another reason why this motion must be denied. Equitv demands of a complainant that he should display great diligence in the assertion and vindication of his rights. Inexcusable delay on his part, though it may not amount to conclusive proof of acquiescence, nevertheless may be and often is sufficient cause to disentitle him to the summary interference of the Court on his behalf by way of interlocutory injunction. Whatever may be the original equities of the case as between the parties, if the complainant stands quietly by, without seeking to enforce his rights, while the defendant expends time and labor and money upon the enterprise sought to be enjoined, upon faith that no actual or effective objection thereto will be made, he will be shorn of any right to appeal to the Court of Equity for assistance. (Hummer v. Hummer, 2 Green (Ch.), 263 ; Whitney v. Union 6, 11 Gray, 359 ; Carlisle v. Cooper, 21 N. J. Equity, 599.)

In other words, the principle has been thus stated : No one can have relief if his own conduct has led to that state of affairs which occasions the application.

The proofs submitted to the Court, on this motion, show these facts. The defendant corporation was organized under the laws of the State of New Jersey in 1888. Its sole purpose was to engage in the manufacture and sale of electric storage batteries of the type known as the Chloride Accumulator. Its works were located at Gloucester in this State ; and from the the time of its incorporation to the present, it has carried on its business without interruption. Its existence and the character and extent of its operations were well known to the principal officers and managers of the complainant corporation. In the conduct of its business at various times, and especially in 1891, 1892 and 1893, the defendant openly installed storage battery plants of the alleged infringing type in various public buildings, and for various corporations. Thus, for example, they furnished plants or batteries to the Provident Insurance Company of Philadelphia ; to the Metropolitan Railway Company of Washington ; to the Union Square Theatre in New York, and elsewhere. The fact that these plants were furnished by the defendants was well known to the complainants. Besides, early in 1893 the defendants issued a pamphlet in which was printed an opinion of Prof. Chandler of Columbia College on storage batteries and which contained a detailed and correct statement of the mode of construction and operation of the storage batteries of the defendants, and a full and succinct comparison between them and the batteries of the complainants. This pamphlet was widely circulated, and admittedly the complainants knew of it.

It was not until 1894, months afterward, that this bill of complaint was filed.

It is hardly necessary to say that the excuses offered do not justify the laches of which the complainants have been clearly guilty.

It was admitted upon the argument that the defendants were financially responsible, and amply able to respond to any award of damages that might be made against them. Under all the circumstances, and for the reasons given, the motion for a preliminary injunction is denied.

Electrolysis.

The damage to its cables in Brooklyn from electrolysis has compelled the Commercial Cable Company to change the location of its cable from the conduit through Brooklyn and bring it around outside of Coney Island and up the bay to this city, where it will be landed at Pier A, North River. When the cable was landed some years ago at Coney Island, about 1,000 feet east of the Oriental Hotel, it was laid underground from that point to the Brooklyn Bridge and over the bridge to the company's office in this city. The company's line, although laid in a conduit and heavily sheathed with iron, has been unable to withstand the effect of this free electricity that seeks a conductor. All appliances the company has been able to obtain have proved of no avail to keep the cable wires from being supercharged.

The Board of Works of Jersey City has been wrestling with the troublesome problem. At a recent session David Young, general manager of the Consolidated Traction Company, was present, accompanied by the company's expert, Harry G. Pierson, while the city was represented by Harold P. Brown, the expert electrician, appointed by the city authorities to look into the matter of electrolysis, submit a report and propose the necessary remedies. After a long informal discussion Mr. Young announced that his company would be satisfied to provide for any effective safeguard to prevent the danger arising from electrolysis that Messrs. Pierson and Brown should agree upon, and Mr. Brown was retained as an expert, under whose supervision the company should introduce a system of relief from the danger of electrolysis.

The Annual Convention of the American Water Works Association has just closed its sessions in Minneapolis. There was a paper on the subject of electrolysis and a lively discussion it was. The consensus of opinion was that electric railway companies and other corporations whose plants cause the trouble in the water mains should provide the remedies, instead of putting the expenses on the several cities.

Signaling Through Space.[*]

BY W. H. PREECE, C.B., F.R S.

Whenever an electric current rises or falls in a circuit another current is simultaneously induced in every neighboring conductor if it form part of a circuit and be separated from the former by some insulating medium or dielectric, such as air. This secondary current flows only during the period of rise or of fall of the primary current.

Hence, if the primary current rises, falls, or changes its direction regularly and repeatedly a given number of times per second, the induced secondary currents will alternate with the same regularity and frequency. The intensity of these secondary or induced currents, among other things, will depend upon the character, form and direction of the circuits, and upon the distance which separates them from each other. That such secondary currents, or electro-magnetic disturbances, as they are called, existed, has, of course, been known since the days of Faraday; but that they could be observed, measured and utilized at a distance of some miles from the primary circuit was not suspected before the introduction of that marvellously sensitive instrument, the telephone.

When these disturbances are rhythmic, musical sounds are produced in telephones fixed in the secondary circuits, but when they are irregular, unpleasant noises alone are heard. If the sounds are preconcerted and directed, like the dots and dashes of the Morse code, then telegraphy is possible, and we have a means of signaling through space without wires. The distance to which we can signal is limited only by the distance to which these electro-magnetic disturbances, in their transit through space, retain sufficient energy to actuate our apparatus. The ether is supposed to be the real medium of transmission, and not the air. The disturbances through the ether take the form of undulations or waves, and in character they are similar to those radiations which at other frequencies give us heat, light and photography. They move with the same velocity; they are subject to the same operations of reflection and refraction; and they differ only in the number excited per second.

Thus, to deal with the subject of signaling through space, we must have a primary conductor, in which vibratory or alternating electric currents can be excited at will. They must alternate with a frequency that will pleasantly affect the ear—say about 600 per second. They must be manipulated so as to produce preconcerted signals. The primary circuit must be freely exposed in the ether; and the secondary circuit, which it is desired to excite, must not be screened from the primary by means of magnetic or conducting matter. The object of this lengthened inquiry has been to determine the best form of primary and secondary circuit, the function performed by the earth as a part of the circuit, and the distance to which communication is possible with the ordinary practical means at our disposal.

The telephone as an instrument of precision is scarcely sufficiently appreciated. The ear can be trained by its aid to measure graduations of sound as accurately as the eye determines the calibrations of engraved scales. In Hughes's induction balance we have a well-determined absolute zero of silence, and there are many well defined nodes of sound which may be taken as fiducial points in a telephonic scale. The limit of speech where articulate sounds cease to be comprehensible is one, the limit of Morse signals where telegraphic reading becomes impossible is another. It is quite easy to determine the similar intensity of two sounds, as in photometry the eye determines the similar intensity of two illuminations. The ear, however, requires to be educated, and it is subject to fatigue; but when properly trained, and when assisted by the telephone, it can be used to observe effects with as much reliability as the eye.

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[*] Paper presented at the Oxford meeting of the British Association.

My attention was first directed to the subject in 1884. In 1886 I brought it before this Association at Birmingham, and again at Manchester in 1887. In August, 1893, I reviewed, before the Electrical Congress at Chicago, the whole of my previous nine years' work. Much experimental work has been done during the past twelve months. In 1884 electro-magnetic disturbances were detected between telegraph circuits and telephone circuits 80 feet apart, the former in the streets underground in London, and the latter on the housetops; but in 1885 these effects were perceptible between parallel lines of telegraph 10¼ miles apart. The permeability of stone walls and buildings to electric waves was shown by Henry in 1842, when the discharges of a Leyden jar in the top floor of his house induced sparks in a circuit in the cellar. Sonorous vibrations were reproduced in a telephone circuit in the basement of the G. P. O. in 1886 by the induction of a primary circuit, excited by the voice in the upper corridor 80 feet away. Speech was found possible between insulated coils of wire a quarter of a mile apart. Telegrams in 1893 were transmitted across a distance of 3·1 miles on the Bristol Channel. Regular communication was held last winter across Loch Ness, a distance of 1¼ miles, and recently at a much greater distance between Arran and Kintyre, across Kilbrannan Sound. Across Loch Ness speech was maintained.

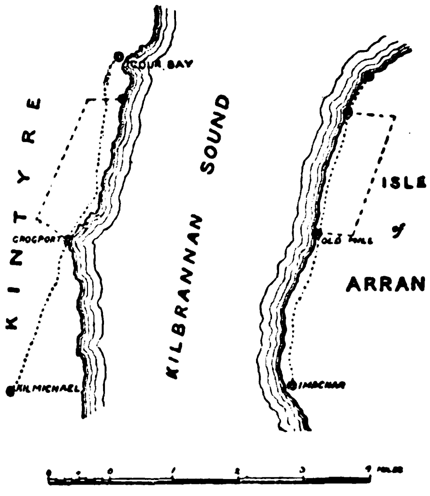

FIG. 1.

But this is not all. There is every reason to believe that we have detected distinct disturbances in our telegraphic circuits, due to great electrical storms in the sun's photosphere, 92,000,000 miles away.

The fact that these signals across space are effects of induction, transmitted through the air or the ether as the dielectric, is beyond the region of doubt, for they were produced between isolated and insulated coils, each forming a complete metallic circuit; but the part played by the earth at short distances, when the earth was used to complete the circuit, was not so clear. Very exhaustive experiments were made on the sands in the Conway estuary in 1893, and again at Frodsham, on the estuary of the Dee, in 1894. These experiments were conducted for me by Mr. Gavey and Mr. H. R. Kempe. Further experiments were made by Mr. Gavey and Mr. Cooper on opposite sides of Loch Ness, a distance of 1¼ miles, and between the Island of Arran and Kintyre, where parallel wires, four and five miles apart, were available for use.

In the Conway estuary and at Frodsham, squares and rectangles were formed of insulated wires, and numerous measurements were made, both with reflecting galvanometers and with telephones, of the effects due to varying currents in the primaries, and at varying distances between these and the secondaries.

At Loch Ness two parallel wires on opposite sides of the Loch were taken. Between Arran and Kintyre (Fig. 1) two parallel lines on opposite sides of the Sound, and four miles apart, were taken, and, in addition, two gutta-percha wires were laid along each coast at a height of 500 feet above the sea level, and five miles apart horizontally.

The general results and the conclusions arrived at may be briefly summed up as follows :

The earth acts simply as a conductor, and *per se* it is a very poor conductor, deriving its conducting property principally, and often solely, from the moisture it contains. On the other hand the resistance of the "earth" between the two earth plates of a good circuit is practically nothing. Hence it follows that the mass of earth which forms the return portion of a circuit must be very great, for we know by Ohm's law that the resistance of a circuit increases with its specific resistance and length, and diminishes with its sectional area. Now, if the material forming the "earth" portion of the circuit were, like the sea, homogeneous, the current flow below the earth plates would follow innumerable but definite stream lines, which, if traced and plotted out, would form a hemispheroid. These lines of current have been traced and measured. A horizontal plan on the surface of the earth is of the form illustrated in Fig. 2, while a vertical section through the earth is of the form shown in Fig. 3.

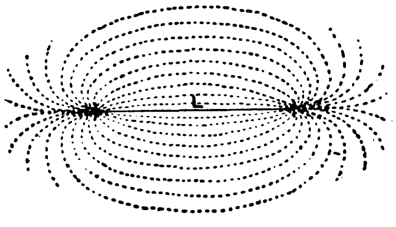

FIG. 2.

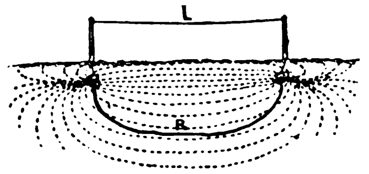

FIG. 3.

With earth plates 1,200 yards apart these currents have been found on the surface at a distance of half a mile behind each plate; and, in a line joining the two transversely, they are evident at a similar distance at right angles to this line.

Now, this hemispheroidal mass could be replaced electrically by a resultant conductor (R, Fig. 3) of a definite form and position, and, in considering the inductive action between two circuits having earth returns, it is necessary to estimate the position from this imaginary conductor. This was the object of the experiments at Frodsham.

If the material of the earth be variable and dry the hemispheroid must become very much deformed and the section very irregular, the lines of flow must be spread out further, but the principle is the same, and there must be a resultant return. The general result of the experiments at Frodsham indicate that the depth of the resultant earth was 300 feet, while those at Conway are comparable with a depth of 350 feet.[*] In the case of Frodsham the primary coil had a length of 300 feet, while at Conway the length was 1,320 feet. At Loch Ness, and between Arran and Kintyre, where the parallel lines varied from two to four miles, the calculated depth was found to be about 900 feet. The depth of this resultant must, therefore, increase with the distance separating the earth plates, and this renders it possible to communicate by induction from parallel wires over much longer distances than would otherwise be possible.

The first and obvious mode of communicating across space is by means of coils of wire opposed to each other in the way familiar to us through the researches of Henry and Faraday. All my illustrations of the principles involved in effecting this object have consisted in opposing two similar coils of wire having many turns, the one coil forming the primary current and the other coil the secondary circuit.

Vibratory or alternating currents of considerable frequency were sent through the primary circuit, and the induced secondary currents were detected by the sound or note they made on a telephone fixed in the secondary circuit.

The distance to which the effective field formed by a coil extends increases with the diameter of the coil more than with the number of turns of wire upon it. A single wire stretched across the surface of the earth, forming part of a circuit completed by the earth, is a single coil, of which the lower part is formed by the resultant earth return, and the distance to which its influence extends depends upon the height of the wire above the ground and the depth of this resultant earth.

In establishing communication by means of induction there are three dispositions of circuit available, viz.: (*a*) single parallel wires to earth at each extremity; (*b*) parallel coils of one or more turns; (*c*) coils of one or more turns placed horizontally and in the same plane.

The best practical results are obtained with the first arrangement, more especially if the conformation of the earth admits of the wires being carried to a considerable height above the sea, whilst the earth plates are at the sea level. By adopting this course the size of the coil is practically enlarged, and even if it be necessary to increase the distance between the parallel wires to effect this object the result is still more beneficial. In a single wire circuit we have the full effect of electrostatic and electro-magnetic induction, as well as the benefit of any earth conduction, but in closed coils we have only the electro-magnetic effects to utilize.

In one experiment, two wires of a definite length were first made up into two coils forming metallic circuits, then uncoiled and joined up as straight lines opposed to each other, with the circuit completed by earth. The inductive effects, and the distance between which they were observable, was very many times greater with the latter than with the former arrangement.

Incidentally some extremely interesting effects of electro-magnetic resonance were observed during the experiments in Arran. A metallic circuit was formed partly of the insulated wire 500 feet above the sea level, and partly of an ordinary line wire, the rectangle being two miles long and 500 feet high. Wires on neighboring poles, at right angles to the shorter side of the rectangle, *although disconnected at both ends*, took up the vibrations, and it was possible to read all that was signalled on a telephone placed midway in the disconnected circuit.

I have not succeeded in determining satisfactorily the general law which regulates the dis-

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[*] These figures are obtained from the use of the formula

$$Q = K \left\{ \log \left(\frac{D^2}{d^2} + l \right) \right\},$$

which is given in Appendix I.

tance to which one can speak, and I scarcely hope to do so, there are so many disturbing elements introduced, geological as well as electrical. In practice we have to deal with two complete circuits of unknown shape and in different planes. We have obtained some remarkably concordant and accurate results in one locality, but we have met with equally discordant results in another locality. I fear we are beyond the reach of the mathematician. In the Appendix I have shown the formulæ that gave the most reliable results.

The mechanism of the mode of signaling across space is not difficult to follow. Its analogue is a flash of light seen at a distance. Energy is expended, say, in a lighthouse on some dangerous rock, or in a gun firing some warning signal, or in a bonfire on some mountain top. The energy assumes the luminous form, exciting the ether to undulate with a frequency of many millions per second, which, acting upon the retina of the eye, produces the sensation called light. The burning of the oil lamp of the lighthouse is the primary source of energy; the rapid undulations of the ether propagated in straight lines at a velocity of 186,000 miles per second are the radiations, transmitting this energy in a wave form to the distant ship; the eye is the apparatus which transforms the energy of the light waves into a form which excites consciousness in the brain.

In our electrical experiments the primary energy is in the current form, the comparatively few hundred alternations per second excite waves in the ether of a few hundreds per second only. But these oscillations of the ether or electric waves are of the same character as those of light, they move with the same velocity, and when they fall on a sympathetic secondary conductor they excite in that conductor currents of electricity of the same frequency; and if a telephone be inserted in that circuit and applied to the ear, sounds and musical notes are distinctly heard, which, by preconcerted measures, such as the use of the Morse code, can be utilized for the transmission of messages. Thus messages were sent across the British Channel between Penarth and Flat Holm Island, 3·1 miles away. Speech was maintained in the Highlands across Loch Ness, 1¼ miles broad, and telegrams were transmitted from Kintyre to Arran, across distances of four and five miles, and thus we could readily communicate between England and France, or between outlying islands and the shore, when the conditions admit of the necessary circuits.

A somewhat fascinating branch of this subject is the possibility of signaling across planetary space. Signaling between one planet and another is merely a question of degree. Magnetic storms and earth currents have some intimate connection with the sun, although Lord Kelvin has questioned the reality of the fact. The great storms and sun spots of March 30 and 31, 1894, were accompanied by very marked and peculiar sounds in telephones inserted in our long telegraph circuits (*vide* Appendix II). The storm of July 20 was not so distinguished. Strange, mysterious, weirdlike sounds are frequently heard on long lines of telegraph in the calm stillness of the night, but whether due to terrestrial or to cosmic causes remains to be discovered. The sun's photosphere when disturbed by spots may be subject to violent electrical storms, and those vast clouds of incandescent hydrogen that flame up with terrible velocity may excite electrical oscillations through ethereal space of such a frequency as to influence our terrestrial circuits. We may thus hear on earth the electrical storms of the sun. But this is mere speculation, and the evidence before us at present is not sufficient to justify positive deduction. We shall continue to watch and record, and it is hoped that observers in other parts of the world will assist by making use of the telephones and telegraph lines at their disposal.

The practicability of this method of effecting communication is now solved, but the subject possesses great scientific interest from the views it imparts of the mechanical character of electrical waves, of the molecular theory of electricity and of the great distances at which electro-magnetic disturbances are perceptible.

APPENDIX I.

The following are the formulæ on which the foregoing calculations are based:

Let A, B (Fig. 4) be an infinitely long wire, and *c* and *d* be two wires forming parallel sides of a rectangular circuit, E, F, G, H; then if a current be set up in A, B, the lines of force cutting E, F and G, H will cause a momentary current to be set up in the rectangle, so that

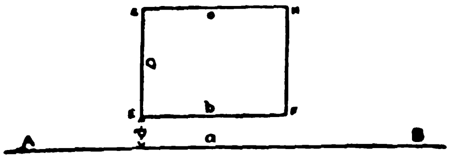

FIG. 4.

$$Q = K \left\{ \log (D + d) \quad \log d \right\} = K \log \frac{D+d}{d}$$

where Q is the quantity induced.

K is a constant depending on the length of the sides G H, E F, of the rectangle in centimeters, the current strength in amperes in the wire, A, B, and the total resistance of the rectangle in ohms.

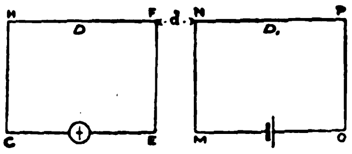

FIG. 5.

Within certain limits this formula is approximately correct, even if the wire, A, B, is not infinitely long, but makes one face of a second rectangle, similar in form to the induced rectangle, E, F, G, H, and set either in the same plane with, or at right angles to, the first rectangle, but in such cases the formula has to be corrected to allow for the influence of the second face of the inducing rectangle as follows:

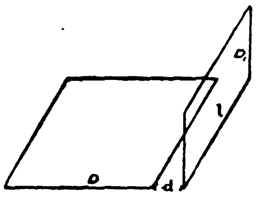

FIG. 6.

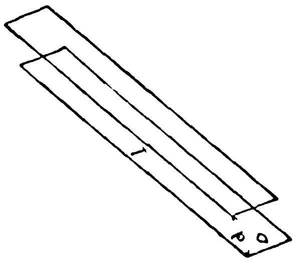

FIG. 7.

With two rectangles in the same plane (Fig 5), the total effects produced by the two faces, M, N, O, P, of the inducing rectangle is

$$Q_1 = K \left\{ \log \frac{D+d}{d} - \log \frac{D_1 + d + D}{D_1 + d} \right\}.$$

If the two rectangles are at right angles to each other (Fig. 6), and *l* is large compared with D, then the formula becomes

$$Q_2 = K \left\{ \log \frac{D+d}{d} - \tfrac{1}{2} \log \frac{D_1^2 + (D+d)^2}{D_1^2 + d^2} \right.$$

Again, if the two rectangles are parallel and equal (Fig. 7) and *l* is large compared with D, then

$$Q_3 = K \left\{ \log \left(\frac{D^2}{d^2} + l \right) \right\}.$$

These formulæ take into account the effect on the wires in the secondaries which are parallel to the primaries, but not the effects of those at right angles to them. The latter oppose the main induced current, so that in practice this current diminishes more rapidly with the distance than the log law indicates. The problem is very intricate, but Mr. Kempe, to whom I am indebted for the formulæ, still hopes to obtain a final and accurate solution.

APPENDIX II.

The following letter appeared in *Nature* April 12, 1894:

Earth Currents.—The Astronomer Royal was kind enough to show me the permanent photographic records of earth currents during the great magnetic storm on February 20-21, and they indicated so unmistakably such rapid and violent alternations that I supplied our principal relay stations with telephones and with instructions to insert them in circuit whenever they observed indications of disturbances. This happened on March 30-31, during the display of the Aurora Borealis. Mr. Donnithorne, in Llanfair P. G., Anglesea, reports: "At 2 A. M. (Saturday) the telephone receiver was again tried, and then 'twangs' were heard as if stretched wire had been struck, and a kind of whistling sound. The strength of the earth current was 17·7 milliamperes." Mr. Miles, in Lowestoft, reports: "Noise on 408 (Liverpool-Hamburg) wire seemed like that heard when a fly-wheel is rapidly revolving," and "sounds in telephone appear like heavy carts rumbling in the distance." Mr. Scaife, in Harvordwest, reports: "March 31, 2:5 A. M. Earth currents on all wires; wires completely stopped. . . . Peculiar and weird sounds distinctly perceived, some highly-pitched musical notes, others resembling murmur of waves on a distant beach. . . . The musical sounds would very much resemble those emitted by a number of sirens driven at first slowly, then increased until a 'screech' is produced, then dying away. Durations of each averaged about 20 seconds." These experienced observers, situated at three distant points, and perfectly acquainted with the ordinary inductive disturbances on telephone circuits, simultaneously observed and independently recorded their own impressions of peculiar sounds exerted in telephones by very rapid alternations or pulsations of currents which accompanied, or were consequent on, sun spots, earth currents and the Aurora Borealis.

An electric locomotive of 1,000 horse-power is, says the *Engineer and Iron Trades Advertiser*, under construction in London, from the plans of Sprague, Duncan & Hutchinson, to the order of the North American Company. It is intended for slow speed and heavy traction in switching service. The machine is carried upon four pairs of driving wheels, all coupled. The frame is of steel, with deep pedestals. The 56-inch wheels are close coupled; the first and last pairs only are flanged. There is a motor in each axle, the weight of the armature coming directly on the wheels, and that of the field magnets is on the journals through the pedestals; no spring supports are used. The four motors all form parts of a complete system on a rigid wheel base of 15 feet. The motors are of the alternating type, are wound for 860 volts, at 225 revolutions, which will be the equivalent of 35 miles an hour when in multiple.

Some Phenomena of Terrestrial Magnetism.

BY PROF. A. W. RUCKER, M. A., F. R. S.[*]

(Concluded.)

The question is interesting from another point of view. It is now fully established that even where the surface soil is non-magnetic, and even where geologists have every reason to believe that it lies upon non-magnetic strata of great thickness, there are clearly defined lines and centers towards which the north-seeking pole of a magnet is attracted, or from which it is repelled. To the magnetic surveyor fluctuations in secular change would appear as variations in the positions of these lines, or as changes in the forces in play in their neighborhood. Greenwich and Kew are both under the influence of a widespread local disturbance which culminates near Reading. At both places the needle is deviated to the west of the normal magnetic meridian, and if the westerly declination diminishes sometimes faster and sometimes more slowly at one observatory than at the other, this must be, or at all events would in the first instance appear to be, due to local changes in the regional disturbing forces. The questions of the nature of the irregularities of secular change and of the causes of local disturbances are therefore intermingled, and information gained on these points may in turn be useful in solving the more difficult problem of world-wide secular variations. Two causes of regional and local disturbances have been suggested, viz., earth currents and the presence of visible or concealed magnetic rocks. The two theories are not mutually exclusive. Both causes of the observed effects may, and probably do, coexist. I have, however, elsewhere explained my reasons for believing that the presence of magnetic matter, magnetized by induction in the earth's field, is the principal cause of the existence of the magnetic ridge lines and foci of attraction which for so many years we have been carefully tracing. I will only now mention what appears to me to be the final and conclusive argument, which, since it was first enunciated, has been strengthened by the results of our more recent work. We find that every great mass of basic rock, by which the needle is affected at considerable distances, attracts the north seeking pole. Captain Creak some years ago showed that the same statement is true of those islands in the northern hemisphere which disturb the lines of equal declination, while islands in the southern hemisphere repel the north pole and attract the south. In other words, these disturbances are immediately explained if we suppose they are due to magnetic matter magnetized by induction. The theory of earth currents would, on the other hand, require that round the masses of visible basalt, and round the island investigated by Captain Creak, currents, or eddies in currents, should circulate in directions which are always the same in the same hemisphere, and always opposed on opposite sides of the equator. For this supposition no satisfactory explanation is forthcoming, and therefore, with all reserves and a full consciousness that in such matters hypothesis differs but little from speculation, it appears to me that the theory that induced magnetism is the main cause of the disturbance has the greater weight of evidence in its favor. If this be granted, it is evident that the position of the main lines and centers of attraction would be approximately constant, and, so far as it is possible to form an opinion, these conditions seem to be satisfied. There has certainly been no noticeable change in the chief loci of attraction in the five years which have elapsed between the epochs of our two surveys. Mr. Welsh's observations made in Scotland in 1857-8 fit in well with our own. Such evidence is not, however, inconsistent with minor changes, and it is certain that as the directions and magnitude of the inducing forces alter, the disturbing induced forces must alter also. But this change would be slow, and as the horizontal force is in these latitudes comparatively weak, the change in the disturbing forces would also be small, unless the vertical force altered greatly. It is at all events impossible to attribute to this cause oscillations which occupy at most eight or ten years. It is possible to suggest other changes in the state of the concealed magnetic matter—alterations of pressure, temperature and the like—to which the oscillations of secular change might be due, but probably there will be a general consensus of opinion that if the slowly changing terms in the disturbance function are due to magnetic matter, the more rapid fluctuations of a few years' period are more likely to be connected with earth currents. It becomes, therefore, a matter of interest to disentangle the two constituents of local disturbances; and there is one question to which I think an answer might be obtained without a greater expenditure than the importance of the investigation warrants. Are the local variations in secular change waves which move from place to place, or are they stationary fluctuations, each of which is confined to a limited area beyond which it never travels? Thus, if the annual decrease in the declination is at one time more rapid at Greenwich than at Kew, and five years afterwards more rapid at Kew than at Greenwich, has the maximum of rapidity passed in the interval through all intervening places, or has there been a dividing line of no change which has separated two districts which have perhaps been the scenes of independent variations?

There are two other lines of investigation which I hope will be taken up sooner or later, for one of which it is doubtful whether the United Kingdom is the best site, while the other is of uncertain issue. If, however, it be granted that the principal cause of local and regional magnetic disturbances is the magnetization by the earth's field of magnetic matter concealed below its surface, the question as to the nature of this material remains to be solved. Is it virgin iron or pure magnetite, or is it merely a magnetic rock of the same nature and properties as the basalts which are found in Skye and Mull? There is, of course, no *à priori* reason why all these different materials should not be active, some in one place and some in another. As regards the United Kingdom, I have, both in a paper on the "Permeability of Magnetic Rocks," and in the description of the recent survey, made calculations which tend to prove that if we suppose that the temperature of the interior of the earth is, at a depth of twelve miles, such as to deprive matter of its magnetic properties, and if we further make the unfavorable assumption that down to that limit the susceptibility is constant, the forces which are observed on the surface are of the same order of magnitude as those which could be produced by large masses of ordinary basalt or gabbro. It would not, however, be wise to generalize this result and to assume that in all places regional disturbances are due to basic rocks alone. We know that local effects are produced by iron ore, for the Swedish miners seek for iron by the aid of the magnet, and in some other cases magnetic disturbances of considerable range are so intense as to suggest that material of very high magnetic permeability must be present. If the concealed magnetic matter were iron, and if it were present in large quantity, it is evident that the results of experiments with the magnetometer and dip circle might be supplemented by observations made with the plumb-line or pendulum. In such a case the region of magnetic disturbance would also be a region of abnormal gravitational attraction. An account of a suggested connection between anomalies of these two kinds occurring in the same district has lately been published by Dr. Fritsche.[*]

Observations made about thirty years ago by a former director of the Astronomical Observatory in Moscow led to the conclusion that throughout two large districts to the north and south of that city the plumb-line is deviated in opposite directions. The deflections from the vertical are very considerable, and indicate a relative defect in the attraction exerted by the rocks in the neighborhood of Moscow itself, and the suggestion has been made that there is either a huge cavity—a bubble in the earth-crust—under the town, or that the matter beneath it is less dense than that which underlies the surface strata on either side at a distance of ten or twelve miles. The magnetic elements have recently been measured by Dr. Fritsche at thirty-one places within fifty miles of Moscow. The experiments were all made within eleven days, so that no correction for secular change is required. They indicate a locus of magnetic attraction running through Moscow itself. South of the town the disturbance again changes in direction so as to show either that repulsive forces are in play, or that there is another magnetic ridge line still further to the south. Dr. Fritsche thinks that these observations explain the gravitational anomalies without recourse to the somewhat forced hypothesis of a vast subterranean cave. He assumes that there is a concealed mass of iron, which approaches near to the surface at Moscow, and also along two loci to the south and north of the city. He attributes the magnetic irregularities to the attraction of the central iron hill, the deflections of the plumb-line to the flanking masses. It is perhaps not inconceivable that such results might follow in a special case, but without the support of calculation it certainly appears that the magnetic experiments point to the existence of the principal attracting mass under the town. This is, in fact, the arrangement shown in the figure with which Dr. Fritsche illustrates his hypothesis. If this is so, the theory would *primâ facie* seem to require that the bob of a plumb-line should be attracted towards, and not, as is actually the case, away from, the centre of the magnetic disturbance.

The second phenomenon on which more light is desirable is the permanent magnetization of magnetic rocks. It is known that fragments of these are strongly but irregularly magnetized, but that the effect of very large masses at a distance appears to be due to induced rather than to permanent magnetism. There are three questions to which I should like an answer. Are underground masses of magnetite ever permanently magnetized? Are large areas of surface masses, say a few hundred square yards in extent, ever permanently and approximately uniformly magnetized in the same sense? Is there any relation between the geological age and the direction of the permanent magnetism of magnetic rocks? Enquiries such as these can only be taken up by individual workers, but I venture to think that the comparison of the observatory instruments and the fluctuations of secular change outside the observatories could best be investigated under the auspices of a great scientific society. The co-operation of the authorities of the observatories will no doubt be secured, but it is most important that the comparisons should in all cases be made with one set of instruments, and by the same methods. Whether the British Association, which for so long managed a magnetic observatory, may think that it could usefully inaugurate the work, it would be improper for me in a presidential address to forecast. Who does it is of less importance than that it should be done, and I cannot but hope that the arguments and instances which I have to-day adduced may help to bring about, not only the doing of the work, but the doing of it quickly.

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[*] Abstract of Presidential Address before the Mathematical and Physical Section, Oxford Meeting of the British Association

[*] "Die magnetischen Localabweichungen bei Moskau und ihre Beziehungen zur dortigen Local-Attraction." —*Bulletin de la Société Imper. des Naturalistes de Moscou*, 1894, No. IV.

Some Advantages of Alternate Currents.*

BY PROF. SILVANUS P. THOMPSON, D.SC., F.R.S.

Amongst electrical engineers there remain a few, chiefly of the old pioneers, who have not grasped the advantages possessed by alternate currents over continuous currents in systems of electric supply. Superstitions still linger that alternate currents are less easy to manage, or are less economical, or are more dangerous, or are less readily measured than continuous currents. There is a special superstition that they cannot drive motors. Such superstitions once set afloat die hard, and sad to relate, they are sedulously fostered by a few interested persons who ought to know better. The present paper is intended to point out a few of the more salient advantages attendant on their use, and to add a few points that have recently claimed the writer's consideration and are not generally known.

It is well known that the economic transmission to a distance of electric energy depends for its success on the use of high voltages or pressures. The reason is that power depends on two factors—current and pressure—and that of these two factors the former current involves some waste in the conductors. If large currents are transmitted at low pressures, there will be either much power wasted as useless heat in the copper conductors, or else the conductors must have such large cross-section that the interest in their prime cost involves a still more serious waste. If small currents are used at high pressure—1,000 volts, 5,000 volts, 10,000 volts, as the case may be—the copper conductors may be small and the interest on their cost a trifling quantity.

Now, this all-important fact to the electrical engineer is absolutely independent of the nature of the current as to whether it is continuous or alternating. The advantage of alternating over continuous currents comes in in the circumstance that high pressure cannot be used in houses without being transformed down to low pressure. Hence the system which admits of transformation by a stationary transformer, consisting merely of two coils wound upon a common core, is to be preferred over that requiring running machinery for transformers.

Again, it is an advantage not only for high voltage systems, as distinguished from low, but in all systems, whether high or low, in which currents of considerable magnitude have to be collected and delivered, that there should be no necessity for employing either in the generating plant or in motor any commutators or sliding contacts with their adjustable brushes and the like paraphernalia. The commutator, the indispensable adjunct of the continuous current dynamo and motor, has long been known to be its weakest part from the engineering point of view. It is complex and costly as compared with other parts. It requires far more attention than any other part of the machine. It undergoes greater wear, and the circumstance that under conditions not far removed from normal it may give rise to serious sparking is also a disadvantage.

Alternate current generators have no commutators. Those types of alternators in which the armature revolves require, indeed, collecting rings (for sliding contacts) and brushes, a device to which the foregoing remarks on commutators scarcely apply, seeing they need no adjustments nor give rise to sparks. But the type of alternators now coming most in favor do not even require these (except on the exciting circuits, where their disadvantages are *nil*), since in them the high voltage armature parts are stationary. The only parts that need revolve are most substantial masses of iron and copper needing no special insulation in their construction, or attention in their operation. To be spared all the troubles arising from commutators and brushes is no small advantage in itself to the central station engineer.

Another advantage of an entirely different character is the greater safety of the alternate currents. With them there is far less likelihood of trouble from leaks in the distributing circuit than if continuous currents were used at the same voltage. This arises from the circumstance that the electrolytic action of the alternate current is so extremely small. If there is a weak point in the insulation of a main or branch conductor where damp can get in to form a path for leakage, the continuous current will find it out and promptly set up chemical corrosion. Corrosion sooner or later ends in setting up an arc, and an outbreak of fire results. The corrosion of water and gas pipes complained of in many districts where a continuous current supply is maintained are unknown where alternate currents are used. The danger to life for equal voltages is, I think, now established to be greater with continuous currents than with alternating, as their destructive action on the tissues is greater.

Again, it is no light matter that while in a continuous current supply there is but one way of moderating or regulating the strength of the current which flows to a lamp or motor from the supply mains at a given pressure, there are two modes of regulation possible if the supply be one with alternating current. In the continuous current case, we regulate by introducing resistances which regulate by wasting power. It is as though when we wanted to put a slow speed on to a power lathe we did it, not by changing the gearing, but by putting a grindstone on the same piece of shafting, and slowed it down by grinding something that would waste the power. But in the case of alternate current, though we may still, if we please, regulate by wasteful means, we have another and non-wasteful way available in regulation—viz., the use of so-called choking coils, or reaction coils, which operate by setting up opposing E. M. F.'s in a purely automatic way—damming back the currents instead of wasting them. The use of choking coils is destined to find a very great increase in services of this kind.

It would be traveling too far from the range of this paper to enter to any great length upon the work that has been done during the past five or six years with combinations of two, three, or more alternate currents of different phases. Two phase and three phase combinations of alternate currents, using three or four wires for their transmission instead of the ordinary two wire system of conductors, are now quite well known and their advantages in special cases are fully recognized. Of course, it will be at once replied that any phase system of currents—that is, a combination of two or three alternate currents, which require three or four wires instead of two—cannot be entirely an advantageous system as compared with simple continuous currents, being more complicated. This is very obvious, and yet the fact remains that with two phase and three phase systems of current one can accomplish results which the simpler systems cannot accomplish, and meet conditions which the simpler systems cannot meet. Without attempting any complete exposition of the phasal systems, let one or two points suffice for remark. It has been found essential, or at least advantageous, in those districts where continuous currents are used on a large scale to depart from the sweet simplicity of the two wire system, and in order to economize in the total cost of copper in the mains to adopt a three wire, or a four wire, or even a five wire distribution, so that sweet simplicity is not always on the side of continuous currents. Again, if a three wire three phase system of alternate currents is used, the total weight of copper needed in the conductors (at equal voltage) is less than in the ordinary two wire system for an equal amount of power, whether that two wire system be with continuous currents or with alternate currents. The main advantage of three wire polyphase alternate current systems (whether three phase or two phase) is, however, the greater facility that they offer in the handling of motors, since they are more readily made self starting than in the case where merely single alternate currents are supplied on a two wire system of distribution.

At the Electrical Congress of Chicago, in the debate on a paper by Mr. Scott, of the Westinghouse Company, on polyphase systems, the writer expressed the opinion that while a polyphase system was adapted to the case of the transmission of power from a single generator to a single motor, in the generality of cases in which the power was to be not only transmitted but distributed to a number of motors at independent points, greater simplicity of the simple alternating current would render it preferable now that self-starting motors were in the market. Bearing, however, in mind the advantages to be derived in the possibility of using two and three phase motors, the author gave considerable thought during the winter to the problem of transformation; and particularly to the question whether it might not be possible to transform alternating currents from two phase to three phase, or from either of these to single phase, or *vice versa*. No mode of doing this was known save by the combination of motor generators as running machines. As one result of his cogitations, he found that such transformation might very readily be effected by stationary transformers, or in the least easy case by stationary transformers with a revolving iron core. The simplest case—that of transforming three phase currents into two phase (or *vice versa*)—involved no moving parts, being effected by using a ring coil (or its magnetic equivalent) with connection made appropriately. For example: if a Gramme ring is connected, as shown in Fig. 1, to a two phase system with 100 volts between A, A, and 100 volts in quadration between B, B, a three phase set of alternate currents may be taken off from the same winding at three equidistant points, P, Q, R, at pressure of 66 volts between each of the three wires. The magnetic field across the coil revolves, and it is preferable to provide a laminated core to complete the magnetic circuit. Such a core may be stationary or may revolve. A simple ring transformed like the above (without revolving coil) was shown by the author at his lecture

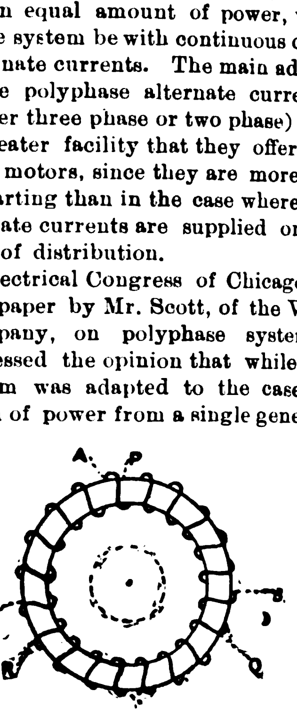

FIG. 1.

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* Paper presented at the Oxford meeting of the British Association.

on the transformations of electric currents at the Royal Institution on February 23, 1894. It is of some interest to note that on March 7 Mr. Scott read an elaborate paper to the American Institution of Electrical Engineers, in which he gave an independent solution to the very same problem, using two sets of winding (instead of one) but working out in detail many possible applications. It is no exaggeration to say that an electrical engineer starting, let us say, with three phase alternate currents as the method of supply is in a position to furnish any customer who may desire either two phase currents or single phase currents with what he desires by merely putting in a small appropriately connected transformer. Another advantage, about which even electrical engineers are as yet almost wholly unenlightened, arises in the application of alternate currents to electro-magnets. Great as has been the services of electro-magnets as used with continuous currents, since their invention in 1825, they are destined to fulfil wider services than ever in the practical problems of an electro-mechanical nature now that their properties, when supplied with alternate currents, are becoming known. In 1887, Prof. Elihu Thomson discovered a number of singular properties of alternate current magnets in producing repulsion of copper disks and rotation of cylinders and balls by reason of the eddy currents induced in them. During the past winter the author has been studying the design, construction and properties of alternate current magnets, and recently, in conjunction with his assistant, Mr. Miles Walker, real a paper on the subject before the Physical Society of London. A few words on this topic will emphasize the advantages offered by alternate currents in this application. It has long been known that the magnetic forces of a magnet fall off very rapidly at small distances from their poles. For steel magnets in those cases in which the poles can be considered as points, the force falls off inversely as the square of the distance, other things being equal. In the case of soft iron electro-magnets operated by continuous currents, the pull on their armatures falls off much more rapidly than this. The forces when in contact may be relatively enormous, and yet the magnet may have no range of attraction worthy of mention. A pull of 150 lbs. in contact may dwindle to a few ounces at a distance of a couple of inches.

But with alternate currents supplied at constant voltage from the mains, the author finds all this to be different. With a properly designed and well constructed electro-magnet, the pull on its armature can be kept fairly constant over a considerable range; nay, in some cases can be caused to be greater at a distance than when near. For example, the author has lately had an alternate current magnet constructed for him by Mr. Walker, the pull of which, when excited at 50 volts, was 8 ozs. when the armature was closely in contact with the core, but which exercised a pull of 32 ozs. when the space between them was 3 inches. This obviously introduces into electric mechanism a new element hitherto undreamed of.

The secret of these things is that in the case of alternate current electro-magnets the self-induction reaction of the system, and not the mere electric resistance of the wires is that which governs the flow of current, whereas Ohm's well known law for continuous current is

$$\text{Current} = \frac{\text{Electromotive force}}{\text{Resistance}}, \text{ or } c = \frac{E}{R}.$$

The rule that governs the alternate current in these cases is different, being

$$\text{Current} = \frac{\text{Electromotive force}}{\text{Reactance}}, \text{ or } c = \frac{E}{p\,L},$$

where p is the pulsation of the alternate current, i. e., the number of radians per second in the revolutions of the circle of reference, and L the inductance.

As the armature of the alternate current magnet is withdrawn from the core, the reactance diminishes and more current flows, making the pull greater at a distance instead of less.

Another curious point about alternate current magnets relates to their winding. In the case of electro-magnets supplied with continuous currents, it is well known that the more turns of wire that are wound on the core the more powerfully is it magnetized. But with alternate current magnets this is not so. There is one particular number of windings for each magnet (generally a small number), for which the magnetism is a maximum, and any additional wire wound on above this number diminishes instead of increasing magnetic power.

Returning from this digression respecting magnets to the general question of the supply of alternate currents, the author has finally to point out one further set of advantages hitherto both neglected and unknown in this country, though known to a few and actually in use in the United States.

One of the difficulties which beset the distribution of electric currents on the large scale is that of maintaining constant, in all points of the network of conductors, the voltage or pressure at which the current is delivered to the consumers. Between the generating station and the center of distribution there occurs a loss of pressure (comparable to the loss of head in the case of water-power), and beyond the center of distribution between it and the points of consumption with house lamps there is a further drop in the voltage. The former drop in the voltage can be compensated for by due arrangements at the central station, but the further drop between the distribution center and the consumers' houses, though it may be guessed at and partially compensated by some system of over-compensating at the distribution center, cannot be accurately compensated. The result is that the consumers' lamps do not receive their supplies of current at an unvarying pressure. Now in the case of continuous current distribution, the only cause for drop in the voltage at distant points is the resistance offered by the conducting wires leading to those points. The drop due to such resistance—or ohmic drop—is proportional to the ohms of resistance and to the amperes of current. Suppose a group of lamps requiring 20 amperes at some outlying point, the wires to which have a total resistance of only one-tenth of 1 ohm. The drop in voltage due to the ohmic resistance will be $20 \times 1\text{-}10 = 2$ volts. The lamps, which ought to receive their currents at a pressure of 100 volts only, return it at 98, and burn dimly in consequence. But in the case of alternating currents there is a second or additional cause of drop, which has hitherto been held to be a serious disadvantage in their use, namely, a drop due to the self-inductive action of the line, reacting and setting up back E. M. F.'s., and tending to choke the current. In general, this second or inductive drop is not serious, the mains and branches being arranged concentrically for the purpose of avoiding it as far as possible; but it may become serious when motors as well as lamps are employed upon the circuit, because of the considerable inductive reactions that are set up in the electro-magnet operations of these machines.

(To be continued.)

The Jenney Company to Move to Ohio.

A deal has been closed by which the Jenney Electric Company of Indianapolis will remove to Springfield, O., and locate their factory in the shops built for the Whitely Reaper Works.

ELECTRIC LIGHTING OF ST. PAUL'S CATHEDRAL.

Within the past twelve months some important experiments have been carried out in London under the direction of Maj.-Gen. C. E. Webber (engineer to the City of London Electric Lighting Company), for the purpose of testing the relative merits of both the arc and incandescent systems of lighting so far as concerned the proposed illumination by electricity of St. Paul's Cathedral. In the electric lighting of cathedrals difficulties arise which are to be met in few other buildings. The enormous height of the dome prevents fittings being suspended from the roof, therefore unless there is to be the disfigurement of cross wires, the lighting of the central portion of the floor must be effected by means of a number of standards, the wires being carried underground. The rays from lights fixed on the walls would not conveniently light the center. Up to the present no system has been decided upon for St. Paul's, but the experiments have enabled the engineer and others interested to arrive at several conclusions on the question of cathedral lighting which have hitherto been obscure. The following are stated to be the general objects of the experiments:

1. To test the comparative value of the arc and the incandescent lamp as an illuminant in places used for public worship, especially with reference to the absorption of light by the stonework of St. Paul's.
2. The possibility of giving sufficient light, without standards or pendants, so that every individual in the congregation occupying so large a space as that under the dome of St. Paul's could read small print with ease; and also to ascertain the volume of light required to give that result.
3. The possibility at the same time of placing the light to fulfil two conditions, namely, so that the glare of the incandescent portion of the lamps should not offend the eyes, either of the congregation looking eastward, or of the occupants of the choir and chancel looking towards the west.

It was proved conclusively by the experiments that these difficult but essential conditions could be attained without cross shadows, and that the illumination was most regular and adequate within the area dealt with, namely, the floor space under the dome. A few other tests were made in isolated portions of the cathedral from which the general results, on a more extended scale, could be estimated.

We understand that before long the detailed results of these investigations and the engineer's own observations regarding "the use and misuse of electric light in ecclesiastical edifices" will be told before one of the London scientific societies.

A Sensible View of the Case.

(From the Boston Beacon.)

The trustees of the Street Railway and Illuminating properties yesterday purchased and cancelled 658 shares of preferred stock, paying an average price of $98.65, and making a total of 14,682 shares purchased to date. If the General Electric Company had not disposed of the valuable assets that are now being realized upon by the above company, there would be good reason, perhaps, for the stock selling at $40 to $45 per share, but as it stands the $30,000,000 common stock is almost pure water and there is not a possibility of the payment of a dividend on it within the next five years. The preferred stock, of which there is only 4¼ millions, and on which there are several accumulated dividends that must be paid before the common gets anything, sells at 72½. On this basis the common ought to be selling somewhere around $10 to $20 per share. The majority of the traders now buying probably forget that the company is a mere shell, not owning enough property to represent its outstanding bonds, the principal assets having been sacrificed in the panic last year

THE POWER OF NIAGARA.

Inexhaustible, and Incomprehensible to Ordinary Minds.

Mr. Ernest Le Suerer has written an entertaining article dealing with the Niagara power scheme. When he treats of the electrical transmission possibilities his views are roseate in the extreme, even more so than those of such practical and experienced engineers as Messrs. Houston and Kennelly.

The figures given, however, in regard to the gigantic force of the Niagara waters are reliable and worth remembering. He says:

"People in general have the idea that the Niagara water power is inexhaustible, and so it probably is, so far as human requirements go. There are, however, some tolerably close data on which to figure the total horse-power. The Lake Survey Board and Mr. R. C. Reid, examining the matter independently, have come to a fair agreement in their conclusions on this point. From their figures it would appear that the average flow is about 270,000 cubic feet per second, and this is almost exactly the same as the unthinkable quality of 1,000,000,000 pounds per minute. A horse power of work is equivalent to 33,000 foot pounds per minute, and as the weight above mentioned falls 161 feet, the horse-power of the total is expressed as follows: 161 × 1,000,000,000 divided by 33,000 equals about 5,000,000.

"Owing to the lack in full efficiency of even the best commercial turbine wheels, we may take the limit of power that could be developed at about 4,000,000 horse-power.

"The average power is not departed from to any great extent at different seasons, as is the case with other water powers, because the spring thaws and summer droughts affect hardly at all the level of Lake Erie, from which the falls get their supply.

"The system of great lakes above Ontario would require a year in order to have their level reduced by 3½ feet by even the enormous drain of 1,000,000,000 pounds of water per minute above referred to, supposing the system to be entirely cut off from its normal supply. A paper of Mr. R. C. Reid before the Royal Scottish Society of Arts in March, 1885, gives the following data: Total watershed area down to Niagara, 290,000 square miles; total lake surface, 92,000 square miles; average rainfall in the lake district, 36 inches—and that we assume 20 inches annually of evaporation and absorption, leaving 16 inches over the whole area finding its way to the lakes. From the lake surface proper there occurs evaporation to the extent of 20 inches per annum. Further, in reference to the enormous storage capacity of the system, he shows that "it would take six months for the full effect of a flood in Lake Superior to be spent at Niagara Falls." It is easy, therefore, to understand how little fluctuation of level there can be due to seasonable variation in rainfall. Thus we see that quite apart from the fact of the vast volume and head available, and of there being no necessity for building a dam to back up the water, the situation is peculiarly favorable to the development of a constant power all the year round.

"In spite of the generally equable level of Lake Erie there are sometimes very considerable fluctuations, not of volume but of distribution, due to high winds sweeping the length of the lake and causing considerable banking of water at the end blown into. Sometimes such storms have lasted for days, and have had a very noticeable effect in increasing or diminishing the volume going over the fall. A more serious cause of low water is an ice jam at the head of the Niagara River. It is on record that in March, 1847, the water practically ceased to flow, "not enough going over to turn a grindstone," as a local paper had it at the time. These circumstances do not, however, affect the evenness of flow to any extent worth mentioning compared with the seasonal variations in rivers in general.

"The total fall between Lakes Erie and Ontario is 329 feet, and is made up as follows: From Lake Erie to the head of the falls, 70 feet; the falls, 161 feet. Consequently, the total power running to waste is more than double the 5,000,000 horse-power on the falls. An idea of the proportion that this total bears to what may be called the world's consumption of power may be had from the fact that it is computed to be equal to the total of all the steam-generated power in the world."

Whatever be the measure of commercial success attained by the Niagara scheme, it is evident that the flow of water at the great falls will not be perceptibly diminished.

The Chloride Accumulator Wins.

Judge Green, in the United States Circuit Court at Trenton, has handed down a decision refusing a preliminary injunction against the Electric Storage Battery Company of Philadelphia, manufacturing the Chloride Accumulator, in a suit brought by the Consolidated Electric Storage Company under the Brush patents. The suit was tried some weeks ago. Judge Green holds that there is reasonable doubt as to any infringement.

The Same Old Game.

But the Suckers are Growing Fewer and Fewer Every Time it is Played.

(From the New York Mercury.)

General Electric sold down five points. Louis Bell offered the stock at the lowest prices. It was Mr. Bell who was responsible for the recent advances on the reports that the company's business is improving. His sales at this time were significant in that he is supposed to represent inside interests.

[The Bell referred to is a Wall Street broker and not our Dr. Louis Bell.]

Chicago Edison Absorbs More Bankrupt Properties.

An order of the court has been issued allowing the assignee of the Co-operative Electric Light Company of Chicago to sell the plant of the insolvent concern to the Chicago Edison Company for $45,000. The plant of the concern is in North State street.

Personal.

Prof. William A. Anthony has associated himself with Mr. Edward P. Thompson, the well known patent attorney. The team is a strong one, and should result in increased business.

Mr. John Orford, of the Boston Electric Light Company, was in town for a few days last week. It was just twenty years last Monday since Mr. Orford entered the electrical field. He has traveled a great deal in the line of his business, and is an entertaining gentleman to meet.

Mr. George A. McKinlock, president of the Central Electric Company, has returned to Chicago after a few days of recreation.

General News.

What is Going on in the Electrical World.

Worthington, O.—Dr. Lowe has been granted the right of way by council to erect poles for electric lights.

Port Huron, Mich.—A committee has reported to the council in favor of the city ownership of an electric light plant.

Atlanta, Ga.—The long distance telephone line to Madison, Ga., from this city has been completed and is now in operation daily.

Allentown, Pa.—Hon. Jeremiah Roth has placed at his farm a motor to thresh, cut feed and pump water, and gets his power from this city.

Mansfield, Ohio.—A company is about to be organized here for the purpose of building an electric railway between this city and Shelby and Galion.

Waco, Tex.—The board of directors of the Cotton Palace intend to place an electric plant at the palace to supply 1,000 incandescent and 50 arc lights.

Lawrence, Mass.—The Lowell, Lawrence and Haverhill Electric Railroad is being constructed under a contract which calls for its completion within sixty days.

Rutherford, N. J.—Delos E. Culver has asked permission of the borough council to use Park avenue for his proposed electric railway connecting Rutherford and Newark.

Camden, Ark.—A new electric light company has been organized at this place. The company will buy out the Thomson-Houston plant here and the concern will be under a home management.

Avon, N. Y.—The Avon Electric Company, composed of Charles J. Bassendorf and A. E. Young, both of Le Roy, have been granted permission to string wires and furnish electric lights within the corporation limits.

Rochester, N. Y.—The directors of the Rochester and Glen Haven Railroad have determined that next season they will run their trains by electricity and abandon the locomotive. No change will be made until the close of this season.

Miamisburg, O.—Under the superintendence of Mr. P. M. Ackert, the city electric light plant presents a very creditable showing. One year ago the plant was $1,000 in debt, now the plant is out of debt and has a balance in its favor of $300.

Bath, N. Y.—The trustees are desirous to change the present electric light system to the Westinghouse system, and the light committee has been directed to confer with the East Albany Gas Light Company in regard to the change.

Baltimore.—Contracts have just been awarded for the construction of the second link in an electric railroad chain from Baltimore to Gettysburg. A line will be built immediately from Pikesville to Reistertown and Emory Grove, the camp-meeting resort.

Oshkosh, Wis.—The franchise lately granted to J. K. Tillotson for an electric railway, and for which he posted a forfeit of $5,000, has been discovered to be invalid because the grant was not published two weeks before its passage by the council.

Louisville, Ky.—The Southern Engineering Company, doing business in this city, have assigned to the Fidelity Trust Company. The liabilities amount to about $12,000, fully covered by the assets. The corporation dealt in electrical machines and such appliances.

Niagara Falls, N. Y.—Contractors have begun the construction of a new street railroad known as the Niagara Falls, Whirlpool and Northern road. The road will be completed this fall and will carry passengers from the northern terminus of the present street railroad to the north city line.

Cincinnati.—Another electrical line, to connect Cincinnati and Hamilton, is contemplated, and it is said that the project is an assured fact. It is proposed to use for the purpose the Cincinnati and Hamilton turnpike road, which, it is claimed, would give a line to Hamilton shorter by five miles than any other road.

Eau Claire, Wis.—The Chippewa Valley Telephone Company propose to put in the Harrison telephone system here as soon as 300 subscribers have been secured. The company promises a very material reduction of rates and are getting subscribers rapidly. An exchange will be opened at Chippewa Falls also if a sufficient number of subscribers is obtained.

Waukegan, Ill.—The Bluff City Electric Street Railway Company as soon as fully organized will apply for a franchise from the city and also one from the board of supervisors, as part of their proposed line will run into the town of Shields. The leading members of the company, which is capitalized at $200,000, are D. L. Jones, S. D. Talcott and Charles Whitney.

Hamilton, O.—The Dayton, Cincinnati and Middletown Electric Traction Company have decided to at once commence work on the construction of their electric railroad from Cincinnati to Hamilton. It is expected that this part of the line will be completed and in operation by the 1st of January, and the whole line from Cincinnati to Dayton may possibly be finished by that time.

Winnipeg, Man.—John Mather, vice-president of the Keewatin Power Company, has submitted to the city council "an offer to supply from 5,000 to 50,000 horse-power of electric energy by long distance transmission to the city of Winnipeg to be used for power, lighting, heating and the many other purposes to which electricity is now and will no doubt in the future be applied."

Yuma, Ariz.—The mills, mines, pumping plants and irrigation works at this point are to be supplied with electric power furnished by dynamos run by a series of immense water wheels placed in the Colorado River at Barrier Rocks, to be completed by the end of this year. The wheel and mill site has been located by Col. D. K. Allen, J. M. Mendiville and Allen J. Smith, representing wealthy capitalists interested in the project.

Juneau, Alaska.—A system of electric lighting is being put in at this place, which is one of the best known of Alaskan settlements and has 2,000 inhabitants. This will be the first plant established in Alaska for street lighting. Electricity, however, is not altogether new in Alaska. It has been used for some time in a limited way in the mines. Water power is abundant everywhere, and the current is generated on the streams and carried to the mines by cables.

Terre Haute, Ind.—The Terre Haute and Brazil Electric Railway Company, which were organized to construct an electric railway line from Terre Haute to Brazil, Ind., have issued a circular for distribution in which they enumerate the advantages to be gained by the operation of an electric railway between the two points. They assert that the railroad will "do a passenger and express business in light freights, milk, vegetables, etc." About $100,000 will be the first cost of the road.

Buffalo, N. Y.—The *Enquirer* says: "S. L. Phillips, president of the Dahl Electric Company of Paterson, N. J., is negotiating for the removal of the plant to this city. As matters now stand there is every reason to believe that the negotiations will be successful. Mr. Phillips holds the only patents in existence, in this country or elsewhere, on a single phase alternating power motor, which is used for running printing presses, sewing machines, ice cream freezers and numerous other kinds of machinery."

Brooklyn, N. Y.—The Long Island Traction Company, it is said, proposes to issue $3,000,000 collateral trust notes for the purpose of extending its city railroad lines. The board of directors as last constituted contains a number of men who are likely to reinvigorate the company. They are John G. Jenkins, William Marshall, John Englis, Theodore F. Jackson, Charles T. Young, besides Daniel F. Lewis, Seth L. Keeney, E. W. Bliss, C. Holden, E. H. Valentine, Silas B. Dutcher and Felix Campbell.

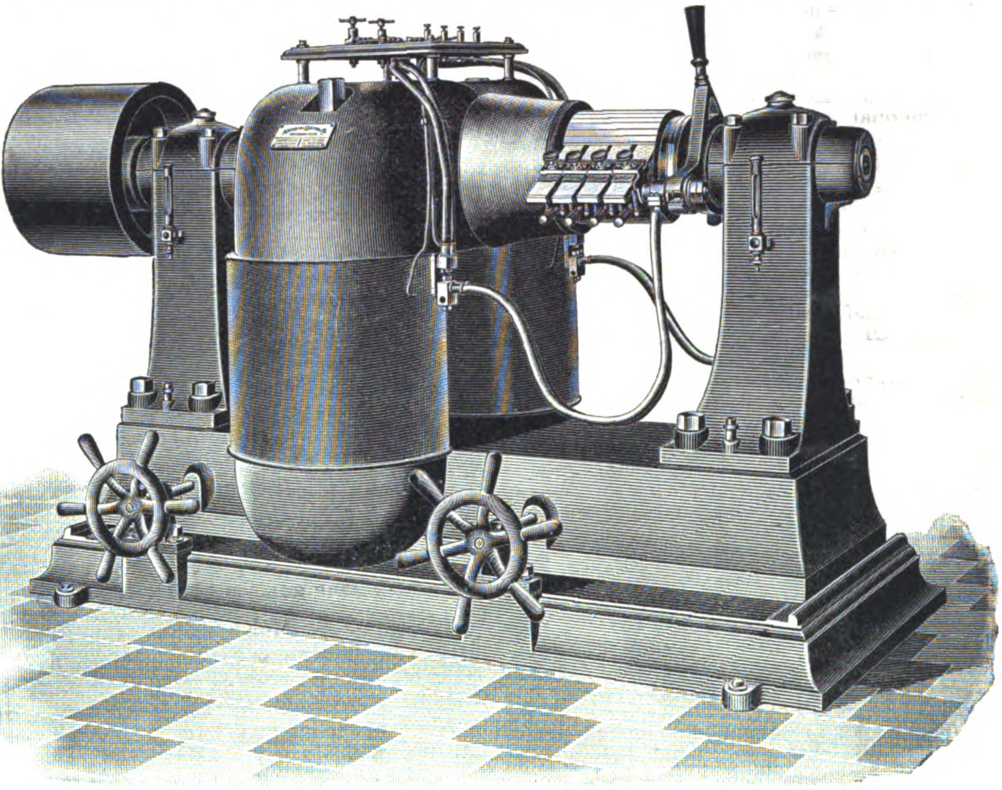
Bridgeport, Conn.—The opening of the new electric street railway line by the Traction Company a few days ago was celebrated with appropriate ceremonies. The first part of the entertainment consisted of a ride over the East End by 250 invited guests who filled eight cars, at the head of which were the leading officials of the road and city. Mayor Bostwick started the first car in motion and the procession moved through the principal streets of the city. They were given a perfect ovation all along the line. After a tour of the route covered by the road the party sat down to a clambake at Avon Park.

Omaha, Neb.—The *World-Herald* in announcing the arrival at Omaha of a crew of twenty linemen who have been placing a telegraph line from Chicago as part of the direct Western Union wire to run from Chicago to San Francisco, says: "The line follows the course of the Rock Island Railroad to this city, the Union Pacific to Ogden and the Central Pacific to San Francisco. The wire is of high grade copper, No. 10 in size, and it will be the largest in use when the circuit is completed. Since leaving Chicago the men have worked from twenty to thirty miles per day, unreeling the wire from a handcar, the linemen following on railroad velocipedes in blocks of five."

Pittsburg, Pa.—Great efforts are being made here to honor the veterans who are to assemble in this city at the Grand Army Encampment on the 10th inst., and electricity is to be perhaps the most prominent feature in the reception. Mammoth electric signs will blaze forth from the top of Mount Washington in Pittsburg and Monument Hill in Allegheny during each night of the encampment. There will be 6,000 incandescent lamps used in each display. Each sign will read, "Welcome, G. A. R.," and can be read easily at a distance of several miles. Other electric illuminations throughout the twin cities will enable the old soldiers to see their way clear to all the enjoyments prepared for them by the liberal and patriotic citizens.

Alexandria, Va.—The plant and franchise of the Potomac Electric Light Company has been bought in at aucton for $15,500 by Mr. Watkins for Mr. Wilder, of St. Paul, Minn., who holds the bonds of the defunct company. Before the sale can be consummated the courts will have to confirm the action. The company was organized about three years ago, with J. C. O'Gorman president. A receiver was appointed in July, 1893, in whose charge it remained until sold at auction. The capital stock of the company was placed at $25,000, though it went further and spent money until $85,000 was sunk in the scheme. The company built the Highview Hotel, at the end of the chain bridge, which still remains in their possession. It is understood that the sale will not close down the plant, but that the work will continue as heretofore.

Philadelphia.—The trolley excursion parties on the People's Railway and the Tenth and Eleventh Streets Railway are yielding a big revenue to these corporations. One night last week not fewer than 58 cars were chartered at $10 apiece for the round trip, representing a total of $580. The excursion "craze," however, has developed some objectionable features. Not a few of the excursionists here seem to think that because trolley rhymes with jolly and folly a ride in the cars gives them an excuse for indulging in uproarious hilarity, expressed in the beating of drums, braying of horns, shouting, singing, throwing of bombs and firecrackers, etc., and the officials of the road have been requested to enforce more decorous behavior among their boisterous customers.—The horse car service on Walnut and Chestnut streets has been entirely superseded by the trolley.



NATIONAL ELECTRIC COMPANY'S DIRECT CURRENT DYNAMO.

San Francisco.—The Market Street Railway Company has purchased the Metropolitan electric road. Under the new management the Metropolitan road will be connected at Golden Gate Park with the present steam line to the ocean. This steam line will be converted into an electric road, so that one may ride from the heart of the city to the ocean beach for five cents.—The Edison Light and Power Company, which has absorbed the California Electric Light Company, is now issuing its stock in exchange for that of the latter company in conformity with an arrangement authorized at a meeting of the directors held last month. The exchange is made at the rate of one share of the Edison Light and Power Company for every 465 shares of the California Electric Light Company, and a dividend of forty cents per share in addition.—In his report to the Superior Court, Receiver Sanford Bennett of the San Francisco and San Mateo electric road says gross negligence and incompetence were gradually bringing the road to ruin.

National Electric Company's Direct Current Dynamos.

The handsome machine represented in the accompanying cut is manufactured by the National Electric Company at Eau Claire, Wis. It is a 50 K.W. direct current dynamo, and the view given will be more convincing as to its correctness, symmetry and beauty of design than the most minute description.

The claims of this machine to distinction on account of its merits as a generator of electricity are apparently well founded. The rounded, easy outlines of the field magnet and its comparative massiveness are particularly to be noted, as well as the comparative smallness of the armature. An observer would at once predict this to be a machine whose powerful field will not suffer great distortion by reason of the armature reaction, and we learn that the operation of the machine justifies such a prediction. By the use of a powerful field, by giving the pole pieces the proper form and bore, by providing ample brush service (a characteristic of National dynamos), and by rating the machine conservatively, the company consider that they have obtained results in smooth and sparkless operation beyond anything heretofore produced. The machines take care of themselves and do not require shifting of the brushes for each variation of the load. By massing the metal uniformly in the magnetic circuit, by using wrought-iron cores, and by carefully determining the proper field windings, a field of maximum strength with a minimum of exciting current is obtained. The efficiency is further promoted by properly constructing the armature core and arranging the winding with a view to reducing armature losses.

The National dynamos run cool and thus spare the insulation from rapid deterioration. The machines are built with armatures of the standard drum type. The cores are built up of thin steel disks, insulated, keyed to the shaft, and clamped rigidly in position. The entire winding is stayed and wedged with fiber strips, and it is firmly banded at intervals not greater than an inch and a quarter along its length, each band being composed of several wraps of phosphor bronze spring wire soldered together; thus the winding constitutes a solid unyielding mass. All parts of the machine are made to standard gauges and templates and are interchangeable.

Chloride Accumulators Abroad.

The readers of our paper who saw the description some time ago of the operation of three of the street railroads of Paris, France, by Chloride Accumulators, will be interested to hear that the Chloride Electrical Storage Syndicate, Limited, sole manufacturers in that country of the Chloride Accumulator, are now operating the street railroads of Birmingham, England, with Chloride Accumlators, replacing the Epstein Batteries which were formerly in use. The chloride cells operate at least sixty miles on every charge, and could do eighty miles if it was necessary, thus enabling each car to be operated with one set of batteries instead of two as has been the practice heretofore. The English Chloride Company has also supplied batteries to Messrs. Mather & Platt for use on the trolley road on the Isle of Man, running between Porte-vada, the Douglas terminus, and the Laxey terminus. "The Electrical Engineer" of London says:

"One of the most noteworthy features in connection with the line is the use of accumulators. At Groudle Glen, situated two and a half miles from Douglas, a battery of 240 cells has been erected in a building specially constructed for the purpose. These cells were manufactured for Messrs. Mather & Platt, Limited, by the Chloride Electrical Storage Syndicate, Limited, of 16 Victoria street, London. They have a capacity of 140 amperes for three hours, or 70 amperes for nine hours, and are remarkable for the exceedingly level curve E. M. F. which they maintain up to the end of discharge, and for the very high rate at which they can be discharged without detriment. The cells are charged direct from the line or from a motor generator. It is intended during the winter months to work the light cars, which will then be sufficient for the traffic after the close of the tourist season, entirely from the battery."

The same company recently equipped the electric launch Aphrodite, the following description of which is taken from "The London Electrical Review" of August 17:

"On Saturday last the Goring-on-Thames regatta was held, and the new electric launch Aphrodite was lent to the Thames Conservancy for the occasion, and was employed for clearing the course during the day. The novel feature of this boat consists in the employment of a battery of chloride cells. The cells with which the Aphrodite is fitted are capable of being discharged at a very high rate, and, on the measured mile, a speed of nine miles per hour has been obtained, and this rate can be continuously maintained for about three hours, which is a record performance for an electric launch of this size; at slower speeds, namely, 6½ miles per hour, which is the usual rate of travel, and which is still considerably above the average speed of electric launches of this size, a day's run of nine hours can be undertaken, inclusive of the time taken through locks."

LA ROCHE GENERATORS IN HARTFORD.

Multipolar Electric Apparatus for the West Hartford and Unionville Road.

One of the most interesting developments in electric street railway progress in this city, says the Hartford *Times*, is the installation of one of the two 350 horse-power multipolar electric generators that will furnish power for propelling the cars on the line between West Hartford and Unionville, which it is expected will be in operation in the course of a few weeks.

The machine is of the six-pole type and was built by the well-known La Roche Electric Works of Philadelphia.

The generator is located at the station of the Hartford Light and Power Company on Pearl street, and another similar to it will be erected there within the next two weeks.

These generators combine the long-established forms with various novel and ingenious improvements, and excellent results are expected from them when in practical operation.

The field is compound wound, the shunt and series coils being wound on a metal bobbin and slipped over the pole pieces and held in place by special-made bolts.

The bearings are self-oiling as well as self aligning, and a great amount of bearing surface is obtained by the great length and diameter of the journals.

The machines are wound for 500 volts, but can be worked up to 550 or 600 volts at the same armature speed by cutting out resistance from the shunt circuit.

The machines are to be belted from a counter shaft which is driven from two cross condensing engines of the Corliss type, being of 2,300 rated horse-power.

The La Roche Electric Company is to be credited for its prompt work, as the generators will be ready to run before even the wires from West Hartford are strung to the station.

A Good Showing.

The Mather Electric Company of Manchester, Conn., report a marked and very satisfactory increase in orders since the passing of the new Tariff bill was assured. Their sales for lighting apparatus alone since then are as follows:

New Davidson Theatre, Milwaukee	two	1,000	lighters
A. W. Perry, Boston, Mass. (fifth order)	one	350	"
Hotel Minot, New York City	one	650	"
Hoboken Quartet Club, Hoboken, N. J.	one	150	"
Henry Reinhardt, New York City, one 100	one	150	"
E. P. Gleason Mfg. Co., New York City	one	250	"
Piscataquis Woolen Co., Guilford, Me.	one	600	"
Danvers Insane Asylum, Danvers, Mass	one	250	"
Newport Gas Light Co., Newport, R. I.	one	250	"
State Almshouse, Tewksbury, Mass	one	600	"
Whittenton Mfg. Co., Taunton, one 100	one	50	"
Weise Bros., Moline, Ill	one	250	"
Chambers Elec. Lt. & Po'r Co., Truro, N. S.	one	500	"
Union Central Life Ins. Bldg., Buffalo	one	250	"
Beck Brewing Co., Buffalo	one	600	"
Comstock Construction Co., Chicago	one	250	"
Gallagher Bros., Meridian, Miss. (3d order)	one	100	"
New Ford's Opera House, Washington	one	450	"

Jones Bros. Electric Co., Cincinnati (seventh order), one 50 H. P. 220 volt generator; New Pittsburg Coal Co., New Pittsburg, O., one 60 K. W. 220 volt generator; Morris Coal Co., Sand Run, O., one 60 K. W. 220 volt generator; Harry S. Smith & Co., Philadelphia, Pa., two 45 K. W. direct connected generators; J. Holt Gates, Chicago, one 250 light dynamo, two 60 K. W. belted generators, and one 60 K. W. direct connected generator.

The Mather Electric Company also report a very large sale of their new Manchester type slow-speed stationary motors, in sizes from 3 to 50 H. P. They have had, they assert, so much success in the introduction of these motors that they have so far been unable to keep up their orders for this class of apparatus.

The Wallace Electric Company's Specialties.

The specialties handled by the Wallace Electric Company, of 307 Dearborn street, Chicago, are becoming well known to the electrical trade, and with the addition of House Goods described fully in their new pamphlet, which will soon be ready for distribution, their catalogue will be complete in every department. This company are now Western agents for the Arc Lamps manufactured by the Electric Construction and Supply Company of New York, and will carry a stock in Chicago. They have Wood's railroad devices, now standard for overhead construction, and Habirshaw Wire, which all who desire a superior insulation are likely to prefer.

The Okonite Company.

The Okonite Company, Limited, 13 Park Row, New York City, are doing a good business in their famous insulated wires and cables, and report that their sales for August exceed those of any other month during the current year. The company anticipate an excellent fall and winter business.

Brown & Sharpe Manufacturing Company.

The Brown & Sharpe Manufacturing Co. and Darling, Brown & Sharpe have resumed work in all departments, the works having been closed for two weeks for repairs and the annual vacation.

INCORPORATIONS.

United States Electric Magnetic Company, Chicago. Capital stock, $250,000. Incorporators: F. S. Lenert, Atlec V. Coale and A. M. Levy.

The Morse Electric Economy Company (incorporated in W. Va.), New York City—to manufacture and sell storage batteries, etc. Capital stock, $5,000,000. Promoters: Lansing Morse, W. F. Herbert, Nathan L. Phipp, all of Brooklyn, N. Y.

The Electro-Magnetic Traction Company (incorporated in W. Va.), Washington, D. C.—to construct electric motors and furnish gears and equipment of street cars, etc. Capital stock, $1,000,000. Promoters: Wm. M. Stewart, Carson City, Nev.; Phil. B. Thompson, Jr., New York City; B. E. Shear, Denver, Col.

The Hartford Electric Street Railway Company, Hartford City, Ind.—to build and operate an electric street railway. Capital stock, $100,000. Promoters: Guy E. Reynolds, Albert Reynolds, M. Allen Walker.

The Lenox Electric Company, Lenox, Mass.—to furnish electric light, heat and power. Capital stock, $20,000. Promoters: Wm. E. Curtis, Isaac I. Newton, Wm. B. Bull.

The Nicholson Light, Heat and Power Company, Nicholson, Pa.—to supply light, heat and power by electricity to the public in the borough of Nicholson, Pa.—Capital stock, $7,000. Promoters: Chas. A. Sisk, Factoryville, Pa.; Francis N. Boyle, Humphrey D. Tiffany, Nicholson, Pa.

The Factoryville Light, Heat and Power Company, Factoryville, Pa.—to supply light, heat and power by electricity to the public in the borough of Factoryville. Capital stock, $7,000. Promoters: Chas. A. Sisk, Walter N. Manchester, Solomon Reynolds, Factoryville, Pa.

The Newport Heat and Power Company, Newport, Pa.—to provide light, heat and power by means of electricity to the public in the borough of Newport, Pa. Capital stock, $1,000. Promoters: I. H. Irwin, W. H. Gantt, Horace Beard, Newport, Pa.

The Detroit Light and Land Company, Detroit, Minn.—to provide light, heat and power for public and private use in and about Detroit in the County of Becker. Capital stock, $100,000. Promoters: E. G. Holmes, E. D. Holmes, J. H. Smith, Detroit, Minn.

The Charleroi, California and Brownsville (Pa.) Street Railway Company—to build an electric railway fifteen miles long to connect the three towns giving the company its title. Promoters: James S. McKean, of Pittsburg; C. F. Thompson, A. C. McKean and others.

The United Telegraph, Telephone and Electric Company, Chicago, Ill.—to furnish a means of electrical communication, to own, build and operate telegraph and telephone lines and to do a general electrical business. Capital stock, $1,000,000. Promoters: Donald McDonald, John G. Earle, Edward P. McConnell.

The Syracuse and East Side Railway Company—to conduct a street surface road, about ten miles long, the terminal to be in the town of De Witt and in the City of Syracuse, N. Y. Capital stock, $200,000. Directors: George B. Leonard, Frederick R. Hazard, H. S. Holden, William Nottingham, David A. Batterson, Willis A. Holden and Jay B. Kline, of Syracuse; John L. Kyne, of East Syracuse, and Clifford D. Beebe, of Dansville.

The Hempstead Traction Company—to construct a street surface road about four miles long in Hempstead, Queens County, N. Y.—Capital stock, $50,000. Directors: Charles L. Barker, Abraham Barker, Miles C. Palmer, E. R. Tilton, T. H. Kilduff and William Kennelly, of New York City; John S. Lawrence and D. L. Lewis, of Hempstead, and John F. Davis, of Brooklyn.

A charter has been issued by the State Department at Harrisburg, Pa., to the Willow Grove and Hatboro Street Railway Company to build and operate a road between Hatboro and Warminster, Pa., a distance of three miles. The company is capitalized at $18,000. Directors: John H. Fow, Philadelphia; Dr. Arthur D. Markley, Samuel J. Garner, James Vanhorn, O. F. T. Robinson, Hatboro; William Halliwell, Abbington; B. Frank Cotleman, Jenkintown; C. F. Ehrenfhort, Willow Grove.

The Ohio Storage Battery Company, Cleveland. Capital stock, $1,000.

The Canton Light, Heat and Power Company, Canton, Ohio—to produce electricity for lighting the streets. Capital stock, $50,000. Promoters: W. A. Lynch, Chas. R. Miller, A. J. Underhill, L. C. Foltz, H. M. Lyman.

The Caldwell Electric Light and Water Company, Caldwell, Ohio—to operate an electric light plant at Caldwell. Capital stock, $10,000. Promoters: T. J. Canneck, Abe Young, Wm. Butler, Chas. McFerren, D. M. McFerren.

The Citizens' Electric Company, Middletown, Ohio—to furnish light, heat and power for public or private use in Middletown. Capital stock, $20,000. Promoters: Thos. Cooper, W. H. Drayer, Wm. Martindale, R. B. Edson, James C. Russell.

The Manchester Stove Company, Manchester, Ohio—to manufacture stoves and other castings and to furnish power for electric lighting and artificial ice plants. Capital stock, $15,000. Promoters: G. H. Halliday, N. Patton, J. W. Jones, Henry Collings, J. A. Sbrin.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED AUGUST 28, 1894.

ELECTRIC RAILROADS AND APPLIANCES.

525,015. Trolley. Naaman W. Haskins, Brooklyn, N. Y. Filed Dec. 1, 1893.

525,016. Trolley-Wire Switch and Crossing. Naaman W. Haskins, Brooklyn, N. Y. Filed April 23, 1894.

525,233. Safety-Fender for Tram, Electric or Cable Cars. Henry S. Robins, Philadelphia, Pa. Filed Sept. 15, 1893.

ELECTRIC LIGHTS AND APPLIANCES.

525,007. Manufacture of Carbon Filaments. Thomas A. Edison, Llewellyn Park, N. J. Filed Dec. 15, 1886.

525,031. Electric-Arc Lamp. Elihu Thomson, Lynn, assignor to the General Electric Company, Boston, Mass. Filed Jan. 24, 1891.

525,035. Electric-Arc Lamp. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company of New York. Filed May 16, 1894.

525,293. Incandescent Electric Lamp Cut-Out. Walter F. Smith, Philadelphia, Pa., assignor to the Heisler Electric Company, Gloucester City, N. J. Filed Aug. 23, 1889.

525,315. Rosette for Electric-Light Wires. David J. Cartwright, Boston, Mass. Filed Jan. 16, 1894.

MOTORS, DYNAMOS, ETC.

525,108. Electric Motor. Abraham V. Meserole, New York, N. Y. Filed Jan. 8, 1894.

525,118. Means for Mounting and Driving Dynamo-Electric Machines. Andrew L. Riker, New York, N. Y. Filed May 19, 1894.

TELEPHONE AND TELEGRAPH APPARATUS.

525,094. Coin-Controlled Lock for Telephones. Pitt Cooke and Joseph L. Harley, Washington, D. C. Filed Jan. 30, 1894.

525,201. Telephone-Transmitter. John Goodman and Henry M. Goodman, Louisville, Ky. Filed May 1, 1894.

BATTERIES.

525,017. Storage Battery. Henry K. Hess, Syracuse, N.Y. Filed Oct. 11, 1892.

525,018. Storage-Battery. Henry K. Hess, Syracuse, N.Y. Filed Feb. 13, 1893.

525,235. Dry Battery. John I. Solomon, New York, N. Y., assignor to the Infinity Manufacturing Company, same place. Filed April 11, 1894.

ALARM AND SIGNALING APPARATUS.

525,020. Electrical Fire-Alarm Apparatus. Ernst W. Jungner, Stockholm, Sweden. Filed Nov. 8, 1893.

525,082. Train-Robber Alarm. Max Z. Levy, Kansas City, Mo. Filed March 27, 1894.

525,277. Electric Time-Signal for Railways. Robert D. Patterson, Lawrence, Mass. Filed Jan. 2, 1894.

525,290. Electrical Railroad-Signal. William F. Seymour, Mansfield, assignor of one-half to Mary E. Seymour, Mount Vernon, Ohio. Filed June 30, 1894.

525,291. Electric Alarm-Lock. John Slater, Hutchins, Pa. Filed Nov. 9, 1893.

MISCELLANEOUS.

525,000. Electrically-Operated Wind-Vane. Lynde Bradley, Milwaukee, Wis. Filed Jan. 31, 1894.

525,001. Insulator. Leonard W. Bradley, Cleveland, Ohio. Filed Feb. 13, 1894.

525,005. Actuating the Valves of Steam-Engines. Aminthe Decombe, Bordeaux, and Pierre Lamena, Pauillac, France. Filed March 14, 1894.

526,056. Cash Register and Indicator with Electric-Alarm Attachment. Joseph B. Nesbit, Sunbury, Pa., assignor of two-thirds to Peter P. Smith and Charles E. Houser, same place. Filed Dec. 13, 1893.

525,092. Fluid-Operated Electric Switch. Jean J. P. Clarlot, Paris, France. Filed Aug. 5, 1893.

525,134. Circuit-Breaker. Cummings C. Chesney, Pittsfield, Mass., assignor to the Stanley Laboratory Company, same place. Filed July 6, 1894.

525,145. Electromagnetic Call-Bell. John J. Geary, Chester, Pa., assignor of one-half to John J. Mossop, same place. Filed Jan. 26, 1894.

525,169. Electric Bell. Richard Varley, Jr., Englewood, N. J. Filed Sept. 21, 1893. Renewed July 10, 1894.

525,266. Circuit-Closing Device. John J. Geary, Chester, Pa., assignor of one-half to John J. Mossop, same place. Filed Feb. 5, 1894.

525,312. Method of and Apparatus for Changing Period and Phase of Alternating Currents. Chas. S. Bradley, Avon, N. Y. Filed July 10, 1893.

ELECTRICITY.

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EDITORIAL NOTES.

Advantages of Alternate Currents. The interesting paper of Prof. S. P. Thompson on the above subject, which is concluded in this issue of ELECTRICITY, contains many convincing arguments in favor of the alternating current systems of distribution for central stations, and predicts that henceforth continuous current plants will be superseded by alternate currents except in a few special cases; and although we are not among "the old pioneers who have not grasped the advantages of alternate currents over continuous currents in systems of electrical supply," we yet think the views of Prof. Thompson on this subject are rather more radical than experience of the relative merits of the two systems warrants at present.

The alternate current has been during the last few years the subject of a great amount of study and experiment, and within this time alternating current apparatus has been so much improved that this system is now beyond doubt the solution of long distance transmission in which capacity its efficiency has been proved. A large proportion of central stations, however, are not designed for the transmission of current over very long distances, and the question between continuous currents and alternating currents—as for most electrical engineers this question still exists—is: At what distance does the alternating current become more economical to install and operate than the continuous current? Beyond a limited distance the alternating current must be considered indispensable on account of the cost of conductors that are required for low tension continuous currents. Of course this saving of copper, as Prof. Thompson points out, is not an attribute of either kind of current, as it depends merely on the pressure adopted, but wherever high pressures are necessary to economy the alternating current must be chosen merely for the facility with which it may be transformed down to a safe working pressure at the point of consumption. The advantages of a stationary induction coil transformer over a dynamotor are to be found in the cost, simplicity and efficiency of the former, but the saving in copper would be the same with a continuous current and dynamotors as with the alternating current and transformers at the same pressure.

The time has now come when both of these systems of distribution are so perfected as to details that no well informed electrical engineer can consistently advocate either one exclusively for all cases. It is very well known that in sparsely settled districts, where the distances to be reached from the station are long, the continuous current is an impossibility from a financial standpoint, while for a compactly settled area, where heavy currents are used and the distances are short, all the advantages are on the side of the continuous current; so it seems that each of these systems has its special field where its use will permit the greatest economy. In a compact system of distribution it is considered the best practice now to run low pressure mains fed at transformer sub stations, and in many cases the extra copper for feeders to these centers of distribution for a low pressure current would be not only more economical but would avoid much complication in the regulation of the system.

In regard to the use of motors the continuous current has still a decided advantage, although polyphase currents will undoubtedly solve the problem of alternate current power transmission. As far as synchronous motors are concerned, their use on a single phase system is attended with considerable difficulty on account of the lack of starting torque, and when it is necessary to start them under a load this difficulty is greatly increased—so much so as to make the use of synchronous motors impossible in many cases.

We do not wish or intend to decry the excellent work which has been done in the development of polyphase currents during the last few years, but merely to point out that the successful developments in this field are adapted more especially to long distance transmission plants than to central stations for local supply. The most important consideration in a supply station from an engineering standpoint is to supply current for any purpose—arc or incandescent lighting, or motive power—from one set of mains and one

type of dynamos. This is attained without any complications by means of the continuous current, and the polyphase systems promise to give equal flexibility to the alternating current, but at the expense of considerable complication. The transformer system of Mr. Charles F. Scott, by means of which transformations of the number of phases in a polyphase system are obtained, promises to be of the greatest importance in alternate current working; but such a system would certainly not be chosen where the distance did not require the use of high voltages. The use of storage batteries might also be cited as an advantage on the side of continuous currents, for while there are laboratory methods of employing them with alternate currents, they are certainly not applicable to central station alternate current distribution. Commutators are not generally regarded in as unfavorable a light as Prof. Thompson seems to hold them—and certainly not when the dynamos are of good design —and even in alternating current stations they are not entirely absent.

The limitations of both of these kinds of current are now fairly well established, and except in special cases there should be but little question as to which should be chosen, as the amount of current to be transmitted and the pressure required will determine the relative economy between the direct and alternating systems.

* * *

Our Words Bear Fruit. It is the opinion of some thinking men that Electricity, instead of injuring the General Electric Company, has been of actual benefit to the company; that we have been in fact the means of saving its life. The theory is an interesting one at least. These gentlemen reason that we pointed out in the beginning the weak spots in the management, the ills from which the company was suffering, the causes of its unpopularity, and pointed them out so often, and with such conclusiveness, that the directors were doubtless forced to take action to remedy a great many of the defects, to get rid of some dishonest men and put safeguards around those remaining in the service.

We cannot agree with this view, but at times something occurs to give it reasonableness.

The latest instance was the publication of our information of last week in regard to the startling shrinkage in the company's supply business, and the turning of a good profit into an absolute loss.

Now we learn that Mr. Beach, who was deposed from the supply department in the East some time ago, has received an offer to return to his old position at a largely increased salary, and that the gentleman who succeeded Mr. Searles in the Chicago office has been removed and a new man, or rather a man from another department, put on in his stead.

The time for the officers of a company to show their business ability is while the business is still theirs, and not after it has gone to others. The profitable supply business of the General Electric Company has gone forever, and for the same reason that the other branches of the business have become too small for any profit—purchasers want fair treatment and prefer to patronize independent concerns.

* * *

Economy of Isolated Plants. The use of isolated electric lighting plants for large buildings, such as theatres, office buildings, etc., introduces an element of economy which is perhaps not generally recognized outside of engineering circles. Mr. A. R. Wolff, in a paper read before the Franklin Institute, calls attention to the subject of isolated lighting in connection with the steam heating of such buildings, and shows its advantages over central station service for them.

The use of steam heating has long since become the rule in large buildings, and from experience with isolated plants the important fact has been deduced that the exhaust steam from the necessary plant for lighting is practically the amount necessary for the steam heating of a building.

As only about ten per cent of the heat of steam is utilized for the mechanical work of driving the dynamos, the ninety per cent. retained in the exhaust is in general about sufficient for steam heating purposes. Aside from the interest on the first cost of the lighting plant, therefore, the lighting of such a building during the cold weather is accomplished at the expense of only a small increase in the amount of fuel consumed. The possible addition of some extra labor still leaves the cost of electric lighting at a figure with which a central station can scarcely compete.

* * *

Accident Insurance. The subject of accident insurance is one of interest to thousands of men in this trade. In no trade or line of business in this country is there more railroad traveling, and there is the constant danger of those at work in factories of sustaining some more or less severe injury. No class of men have greater need of carrying reliable accident insurance.

The misfortune and injustice sustained by an injured man from carrying it in a company or companies which violate their obligations are so manifest as not to need comment.

Many a man of family is staking every dollar he has in his business ventures, relying entirely for the support and comfort of his family after death, if death comes early, upon insurance, either life or accident, or both.

When, therefore, it is found that certain companies, of whatever standing in the business world, have refused, without any semblance of legitimate reason, to carry out their contract with an insured man it immediately becomes of general concern. Men want to know whether they are paying premiums year after year for something or for nothing.

These remarks have been called forth by the treatment accorded to Mr. John L. Martin, of Chicago, who had the misfortune to lose one of his arms in an accident some months ago. Mr. Martin is an estimable gentlemen, of unblemished reputation, and yet two of the companies in which he was insured have refused absolutely to pay him the insurance which is his due. These companies are the Travelers of Hartford and the United States Mutual Accident Association of New York. They offer in defence of their rascally conduct, we believe, only one excuse, that Mr. Martin intentionally fell under a moving train and had his arm run over for the sake of getting the insurance. Not one man in the electrical trade can be found to believe this absurd claim.

We trust that every electrical man carrying insurance in either the Travelers or the United States Mutual Accident company will drop it, and that those seeking new insurance will place it in other companies until the companies mentioned are forced to carry out their contract with Mr. Martin.

* * *

There will be developments in General Electric within the next few months of a more sensational nature than anything which has yet occurred in the history of that ill-starred organization. And Mr. C. A. Coffin will be in it.

* * *

Mr. Philip A. Emanuel, of Aiken, S. C., announces that he has invented a machine which "will furnish electric currents and power cheaper than any steam engine now made can produce steam." He wants capital to develop his invention, and offers to submit drawings, etc., to any responsible person who will give a guarantee of good faith. He is apparently a sensible man, and we wonder what he has got.

Obituary.

His Excellency Hermann Ludwig Ferdinand von Helmholtz died in Berlin on Saturday last after a second stroke of paralysis.

Prof. Von Helmholtz was born in Potsdam, Germany, August 31, 1821, his father being a professor in the University of that city. He entered the University of Berlin at the age of 17 with the object of studying physics, but was compelled by circumstances to take a medical course instead. After practising for a short time as army surgeon in his native city, he received the appointment of Professor of Anatomy at the Academy of Fine Arts in Berlin in 1845, and in 1847 he published a small work in which he demonstrated his discovery of the conservation of energy. He also showed that heat is a rate of motion and that all the processes of nature conform to the laws of mechanics. These discoveries, which mark an epoch in the history of science, were at first rejected by all but one member of the Berlin Academy.

In 1850 Helmholtz invented the myographion and in the year following he invented the ophthalmoscope. In 1855 he was made Professor of Anatomy and Physiology in Bonn, and for ten years he devoted himself to researches in the science of optics and investigated the mixture and visual action of the colors of the spectrum. In his "Manual of Physiological Optics," which he published at that time, all the facts were verified by his own experiments.

He next accepted the chair of Physiology in the University of Heidelberg. Here he published his work on "The Doctrine of Tone Sensations as a Physiological Basis of the Theory of Music." He was appointed Professor of Physics in the University of Berlin in 1871, and from that time his work has been chiefly in the science of electricity. Since 1887 Helmholtz had presided over the technical institution founded by the German Empire in Berlin and has also been director of its department of pure science. Helmholtz was honored by the German Emperor in 1883 with the degree of hereditary nobility; in 1873 the Copley medal was awarded to him in recognition of his service to science by the Royal Society of London.

At the Edinburgh meeting of the British Association in 1892 Helmholtz lent his support to the international adoption of the fundamental electrical units, and in 1894 he was a delegate from Germany to the International Electrical Congress held at Chicago, of which body he was chosen honorary president.

In the remarkable scope of his scientific attainments Prof. Von Helmholtz was without a peer, and by his death the world loses the most noted discoverer in physical science.

New York Electrical Society.

The 160th meeting of the New York Electrical Society took place on Thursday evening last when about 200 members met at Ambrose Park to inspect the electric lighting plant by which the arena and buildings of Buffalo Bill's Wild West Show are illuminated and afterwards attended the evening performance. The occasion proved a most enjoyable one to all present. At 7:30 the party assembled at the grounds when, with representatives of the Brooklyn Edison Illuminating Company, which installed and operate this plant, they commenced a tour of inspection.

The plant consists of two cross compound 300 H. P. Ball engines, four 100 K. W. Edison generators and two 250 Climax boilers. The plant furnishes current for seventy-seven 2,000 C. P. Ward arc lamps, 808 16 C. P. incandescent lamps, fifty 4,000 C. P. focussing lamps with mirror reflectors, and three 10,000 C. P. searchlights. The 2,000 C. P. arc lamps and one-half of the incandescent lamps are used for lighting the grounds, and the balance of the installation for lighting the arena.

It was necessary to place the 4,000 C. P. focussing lamps at an angle of about 45 degrees, and on this account the lamps were especially reconstructed by the Edison Company. These lamps were originally the old German Pieper lamp.

On account of the quick manipulation necessary with the searchlights, hand-feeding lamps were used. This reduced the weight of the lamp so as to enable a quick movement, necessary in following glass balls or different objects of the arena.

The arena occupies a space containing 1 04,600 square feet, and the curtain scene, located at the further end of the horse-show arena, contains 20,456 square feet. This large space is so lighted that the direct rays will not get into the eyes of the audience, actors or horses, and will not cast shadows.

The plant is run as a regular annex station of the Edison Company of Brooklyn, with Mr. M. B. Bailey in charge of the lighting. The plant was erected in four weeks and all foundations are carefully piled. The original contract with the Buffalo Bill's Wild West was for six months, but this will probably be renewed for another six months.

The current for the grounds is distributed direct from the station, and the current for the arena is distributed from a small building on the roof of the grand stand, in which is located the switchboard for controlling the arena lighting and also the searchlights.

After completing the inspection the party divided into two groups, one of which went upon the roof to witness the operation of the searchlights, the other remaining on the grand stand. At the close of the performance, during which the remarkable effectiveness of the illumination was evident, Col. William F. Cody, in an address to the members, stated that the lighting service was the best that he had ever received in the history of the Wild West, either in Europe or America.

The Edison Illuminating Company, which, under the direction of Mr. Barstow, installed this plant in an incredibly short time, and Col. Cody were warmly thanked by the members for the pleasant and instructive entertainment afforded them.

Standards of Electrical Measurement.

(From our London Correspondent.)

The Board of Trade have for some considerable time had before them the question of standards of electrical measurement, and the outcome of their consideration is expressed in a schedule promulgated by command of Queen Victoria (at the advice of the Board of Trade) on August 24, giving the following new denominations of standards as required for use in the electrical trade :

I.—STANDARD OF ELECTRICAL RESISTANCE.

A standard of electrical resistance denominated one ohm, being the resistance between the copper terminals of the instrument marked "Board of Trade ohm standard, verified 1894," to the passage of an unvarying electrical current when the coil of insulated wire forming part of the aforesaid instrument, and connected to the aforesaid terminals, is in all parts at a temperature of 15·4 C.

II.—STANDARD OF ELECTRICAL CURRENT.

A standard of electrical current denominated one ampere, being the current which is passing in and through the coils of wire forming part of the instrument marked "Board of Trade ampere standard, verified 1894," when on reversing the current in the fixed coils the changes in the forces acting upon the suspended coil in its sighted position is exactly balanced by the force exerted by gravity in Westminster upon the iridio-platinum marked A and forming part of the said instrument.

III.—STANDARD OF ELECTRICAL PRESSURE.

A standard of electrical pressure denominated one volt, being one hundredth part of the pressure which when applied between the terminals forming part of the instrument marked "Board of Trade volt standard, verified 1894," causes that rotation of the suspended portion of the instrument which is exactly measured by the coincidence of the sighting wire with the image of the fiducial marked A before and after application of the pressure, and with that of the fiducial marked B during the application of the pressure, these images being produced by the suspended mirror and observed by means of the eye piece.

In the use of the above standards the limits of accuracy attainable are as follows :

For the ohm, within one-hundredth part of 1 per cent.

For the ampere, within one-tenth part of 1 per cent.

For the volt, within one-tenth part of 1 per cent.

The coils and instruments referred to in this schedule are deposited at the Board of Trade Standardizing Laboratory, 8 Richmond place, Whitehall, London.

The schedule is accompanied by a couple of lengthy specifications; the first explains a method of making measurements and also other details; the second specification is on the "Preparation of the Clark Cell," the various headings being "A Definition of the Cell," "Preparation of the Materials," and "Instruction to Set Up the Cell."

Three-Wire System in Italy.

A central station for electric lighting has recently been installed in Jesi, Italy, of which an exchange gives the following description :

The station is situated in the lower part of the town, where a turbine-house has been erected close to the Canal Pallavicino. The available water supply amounts to 4,300 liters per second, the useful fall being 16½ feet. There are installed two 100 H. P. turbines, constructed by Messrs. Calzoni, of Bologna, on the American reaction type, and provision has been made for the laying down of a third turbine. The turbines drive by means of bevel gear two horizontal shafts, which, by means of Raffard flexible couplings, actuate two dynamos at 360 revolutions a minute. Messrs. Siemens & Halske have supplied the whole of the electrical plant. At present two dynamos giving 510 amperes at 130 volts are installed, the current being distributed on the three-wire system. A separate circuit is provided for the requirements of the town, a second for the arc lamps, and a third for private consumers. The town is supplied with 300 16 C. P. lamps, which are alight throughout the night, and 18 nine-ampere arc lamps, eight of which are switched out at midnight. Messrs. Moleschott, of Rome, the representatives of Messrs. Siemens & Halske, have carried out the whole of the electrical and hydraulic portions of the work.

The Ferranti Effect.

Mr. J. Sahulka read a paper recently before the Technical High School of Vienna, describing the Ferranti effect, which he treated from a mathematical standpoint. He explained that the Ferranti effect includes a series of phenomena which occur if the secondary circuit of a transformer, in which the primary is connected to an alternating current machine, is closed through a condenser. The principal phenomenon is that the ratio of transformation increases. At the same time the primary difference of potential also becomes greater and the primary current weaker. The condenser must not have too great capacity, as very large condensers in alternate-current working have only a small apparent resistance, and a condenser of infinitely great capacity might have the same effect as if the secondary circuit was short-circuited through a piece of wire. The ratio of transformation through the insertion of the condenser in the secondary circuit can be greater than the relation of the number of windings of the transformer. The cause of the effect lies in the so-called distribution of the magnetic lines of force in the transformer. This assertion is shown theoretically, and was confirmed by experiment. If all the magnetic lines of force produced by the primary circuit were passed through the whole of the windings of the secondary circuit and reversed, the Ferranti phenomenon would not arise.

COMMUNICATION.

Editor of ELECTRICITY :

I have read with much interest your editorial reference to the Atlanta Convention and thank you for your kind and appropriate mention of the comparative attractions of the Shenandoah Valley route. But some people not familiar with the situation might be misled into a belief that the Pennsylvania Railroad and the Norfolk and Western Railroad are competitors, whereas the two are friendly connections. Both lines exchange business daily. Our competitors are south of Washington and not north of it.

Yours truly,
L. J. ELLIS,
Eastern Passenger Agent N. & W. R. R.
New York, Sept. 11, 1894.

Some Advantages of Alternate Currents.—II[*]

BY PROF. SILVANUS P. THOMPSON, D.SC., F.R.S.

Alternate current motors are of many sorts, but may be grouped under two chief classes, the synchronous and asynchronous. Synchronous motors are only those which run at one fixed speed determined for them irrespective of their load—a speed determined solely by the number of their own poles and the number of the alternations imposed upon the current by the generating machinery at the station. They must either run in synchronism with the pulsations of the current or not run at all. The other class, the asynchronous, are mostly polyphase machines, requiring two phase or three phase currents to operate them. The phase currents, led into a suitable armature, there combine to produce a rotating magnetic field, and in this rotating field masses of iron, or iron carrying closed circuits of copper, are set into rotation, being magnetized inductively and dragged round by the reaction of the eddy currents induced in them. The rotor or rotating part of the asynchronous motor may be regarded as a revolving field magnet, not magnetized by any special exciter or initially, but magnetized only by the eddy currents induced in it. Now if it could spin at the same rate as the revolving magnetic field that surrounds it, there would be no relative motion, no eddy currents, no reactions, and no driving force. It is driven by forces which depend for their existence upon the rotations not being synchronous with the pulsations of the currents in the circuits. Within certain limits it adjusts its speed so that its magnetic slip is proportional to the turning moment which it is called upon to exert.

Now, owing to these necessary reactions, the asynchronous motors produce upon the mains which supply them an inductive drop, and cause the pulsations of current to lag in phase behind the impressed pulsations of voltage. Whereas the ohmic drop is not accompanied by any lag of phase in the current, the inductive drop is so accompanied. Happily, with alternate currents, there exists more than one remedy. It has long been known that a condenser exercises a reaction of another kind, which, though it tends to choke the current, does so not by retarding the phase of the pulsation, but by accelerating it. This precious property has long been known and used in submarine telegraphy to compensate, by the use of condensers, the retardations of the signals. But to apply condensers to systems of alternate current supply for the purpose of counteracting the inductive drop when motors are used would be a rather formidable task; the remedy is too heroic for the malady.

A remedy of a different kind is, however, possible, and must before long become general when its advantages are known. To explain it we must return to the subject of synchronous motors, about which little has been said. It was shown in 1868 by Wilde, and in 1879 by Hopkinson, that two alternate current machines could run together synchronously, one as generator, the other as motor, the one which served as a motor adjusting itself so that its pulsation of E. M. F. tended (as in all motors) to oppose those of the impressed E. M. F. In 1884, Dr. Hopkinson further predicted that an alternate current machine could run as a motor, even if its mean E. M. F. was higher than that of the circuit, a result verified in practice by Mr. Mordey in 1890. In 1892, Mr. Mordey gave at the Institution of Electrical Engineers some further results of alternate current working, including a very remarkable curve, here reproduced, showing the dependence of the armature current upon the excitation of the field magnets of the motor when loaded with a given load. To this curve and its meaning the author directed attention at the time, and he has given much thought to it. It will be found to be most significant. The curve presents the form of a letter V. The lowest point corresponds to a particular state of things, namely, that the motor having its magnetism excited to a practical degree draws a certain minimum amount of current from the mains, in order to drive its mechanical load at the speed imposed upon it. But to do the same work, drive the same load at the same speed, will take more current from the mains if the excitation of the magnets is either more or less than this particular amount. This seems very strange, but the explanation and its consequences are no less so. The particular stage of excitation which makes the armature current a minimum for the particular load in question is that stage which corresponds to there being no difference of phase between the pulsation of impressed voltage and those of the resulting current. Suppose, for example, the armature had a resistance of ½ ohm, and that the current was supplied at 100 volts, and that a current of ten amperes was found the minimum current that would drive the load. It would be found (approximately) that the excitation corresponding to this minimum current would be such as would make the motor work with a back E. M. F. of 95 volts, for thereby Ohm's law $(100 - 95) \div \frac{1}{2} = 10$ amperes. But now suppose the excitation is lessened, the machine acting at the same unalterable speed will generate less than 95 volts. Suppose it drops to 90 volts. Then, if nothing else happened, the current would increase to $(100-90) \div \frac{1}{2} = 40$ amperes. But 40 amperes at 90 volts is much more power than 20 amperes at 95 volts, and is more than is wanted for the load. What must happen? The machine is synchronous and cannot—physically cannot—run faster so as to take up this power. It tries to do so, with the result that it shifts the phase of its readings, the current now lagging in phase behind the impressed E. M. F.; choked down, in fact, from the 40 amperes to something more than 20; choked down, in fact, in such an amount as would, if multiplied by the cosine of the angle of lag and by the 90 volts, come up to the same product as the original volts and amperes, viz., $95 \times 10 = 950$. The synchronous motor, if *under* excited, acts then as a choking coil, producing a reaction drop. But continue the experiment the other way. Suppose the excitation is increased so that the 95 volts become 100 volts $(100-100) \div \frac{1}{2} = 0$, and there would be no current at all to drive did not an adjustment of phases come into play. Instead of the current dropping to zero, more current than before now comes into play, and that current has its pulsations in advance of those of the impressed voltage, there being now an angle of *lead* in the phase relations. In other words, the synchronous alternating motor if *over* excited acts as a condenser, and instead of producing a drop in the voltage tends to raise it by compensating the inductive drop, due to self-induction in other parts of the circuit. When the importance of this deduction from Mr. Mordey's curve dawned upon the author, he began to test it upon the mains of the City of London Electric Light Company. But before experiments could be even arranged he learned that the same conclusions had been arrived at by the officials of the General Electric Company at Lynn, Massachusetts, and that they had found it in practice to work out favorably. By the courtesy of Mr. W. F. Parshall, one of the engineers of that company, who has been associated for long with Prof. Elihu Thomson, Mr. Steinmetz, and other engineers, the author is able to state the following particulars. They found that in a line where self-induction played the part of a choking coil it did not matter very much whether the voltage needed for driving the current through the line and machine were situated mainly in the generator or in the motor, as the mean voltage in the line was not far from a mean between that of the two. Accordingly, in a three phase power transmission at Hartford, Conn., of 300-kilowatt output the motor was arranged to be over excited. Later, after Mr. Steinmetz had submitted the question to calculation, this feature was introduced into the synchronous motors used in all their recent power transmissions, so that by proportioning the armature reaction and the over excitation to the self-induction likely to arise, the voltages on the circuit remain quite constant regardless of load within the capacity of the machines. In thanking Mr. Parshall for his information, I may add two points for comment. The advantage so to be derived from over excitation have indirectly another advantage, viz., that for single transmission cases the motor and the generator may be designed and constructed as identical machines, instead of the motor being made smaller than the generator. Further, the regulation of the voltages in such a network as that of the City of London Electric Light Company, instead of being made more difficult when motors are much used—as was feared by some engineers—will be more easy, provided the motors are of the over excited synchronous type. For the acceleration of phase these produce in the current not only tends to compensate for the inductive drop in the mains and transformers, but tends to reach right back through the system to the generators in the central station, acting on them as a compound winding would, and assisting them not only to counteract the inductive drop, but also the ohmic drop, both between the consumers' lamps and the distributing points, and also between these points and the generating station.

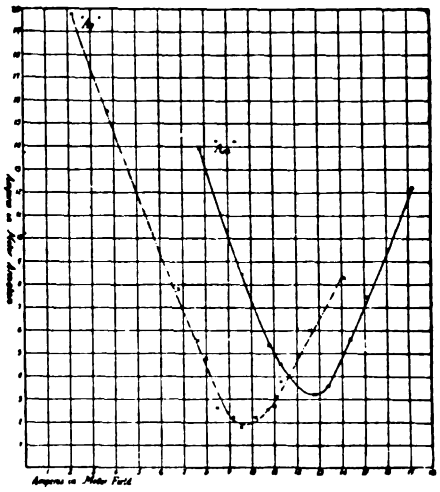

FIG. 2.

So manifest is this advantage, that it would seem worth while to erect at one or possibly more points of the network, as remote as possible from the generating station, synchronous motors over excited, to act as condensers in compensating the inductive drop, or in the primary circuit, also to furnish the idle currents for magnetizing the transformer primaries.

With such possibilities open in the future for alternate current working, and with such advantages in respect of motive power over continuous current working, it can hardly be doubted that, save in a few special cases, the vast majority of central stations will henceforth be operated by alternate currents.

An electric railroad connecting Narragansett Pier and Watch Hill, R.I., is being talked about.

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[*] Paper presented at the Oxford meeting of the British Association.

The Hunting of Governed Engines.[*]

BY JAMES SWINBURNE, M. I. C. E.

Lord Rayleigh pointed out some years ago[†] that the ordinary explanation of the action of the electro-magnet in an electrically-driven tuning fork is incorrect, and that such a mechanism works in virtue of the self-induction of the electro-magnet. As far as the action of the contact goes it is the same whether the leg of the fork is receding from the magnet or approaching it; and if the force depended only on the contact, and was symmetrical, no power would be supplied to the system. It would be like a pendulum which is acted upon by gravity equally whether the bob is going up or coming down. To make the pendulum work continuously gravity would have to act more when the bob is coming down. As this cannot be arranged a clock has to do the work instead. In the case of Lord Rayleigh's tuning fork the magnet pulls harder when the leg is coming toward it than when receding, and thus gives power to the fork. In other words, the effect of the magnet lags and thus becomes unsymmetrical. This is a most important principle, and it applies to a large number of varied cases of great importance and of more interest to engineers than even electrically-driven tuning forks. Broadly speaking, all kinds of continued vibration may be said to depend on this principle. Among these cases is that of the hunting of governed engines.

If a governor really behaved as it does in most text-books, and admitted steam in exact accordance with the speed of the engine, there would be no such hunting; but, unfortunately, a governor does not follow the variations of speed instantaneously. Apart altogether from questions of friction or movement of heavy valve or expansion gears, many forms of governor, especially what may be described as the relay kind, alter the steam admission with some delay. The friction of the various parts and their tendency to remain in one position until the disturbing force comes up to a certain value, and to then move suddenly and overshoot the mark, increases this action. The result of this time lag in the action of governors is that in many cases engines, especially on light loads, get into a state of vibration known as hunting.

The orthodox way of treating such a subject would be to begin with the discussion of an engine with a flywheel and a frictionless governor with a dashpot or something of the sort, following a simple law. A system might thus be imagined which would fit a differential equation such as that used to find the current when an electrical condenser is discharged through an inductive circuit; and it might be possible to calculate the load which would just prevent permanent hunting, or any hunting at all. There are immense difficulties, however, for there are so many small causes of disturbance that such treatment would probably give no useful information. It may be best, therefore, to discuss the question verbally only, without expecting to arrive at very definite results.

When the load of an engine varies, for instance, by decreasing, if the steam supply remains the same, the extra energy goes to increasing the speed of the flywheel. Whether the speed of the engine follows the steam supply quickly or not thus depends on the flywheel. It also depends on the load. If 1,000 H. P. is working at full load, and 900 H. P. is suddenly thrown off and the governor does not act instantly, 900 H. P. is devoted to increasing the velocity of the flywheel, and unless the wheel has an enormous amount of inertia, or is turning very quickly, this power will increase its speed, say 2 per cent., in a very short time. On the other hand, if the engine is only doing 100 H. P., and this load is suddenly reduced to 10 H. P., there is only 90 H. P. to increase the speed of the flywheel, and to increase it 2 per cent. would take ten times as long as in the former case. Putting the matter the other way, the engine obeys variations of steam supply more slowly at light loads, or, in other words, it obeys its governor more tardily at light loads. In practice, many engines which run steadily at full load hunt terribly when worked light.

Turn now to the governor. It is generally treated as complete in itself without reference to the flywheel or engine load. A simple Watt governor and most of the governors on small engines have no appreciable time lag, except a certain sticking due to friction, or the absurd practice of putting a comparatively small governor to work direct on to a heavy expansion gear, or a stiff stuffing-box. These matters have been discussed in an able paper by Ransom[*] recently. There is not very much tendency to hunting with such governors. Their drawback is that as the steam must be nearly shut off at no load, and full on at full load, the valve gear must be in different positions, and the governor must, therefore, be in different positions, too. This means that the engine will be governed at a considerably higher speed at light loads. To cure this the obvious course is to make the governor isochronous. The drawback to this is that an ordinary isochronous governor is not powerful enough if it has to move through a long range with a very small percentage of speed variation. It is likely to stick until the speed has varied a good deal and then to move to its fullest extent. The result of this would be that the engine would be governed by having full steam and none at all alternately. I do not know why this method of governing should not be employed. If the governor works some light gear, such as the various modifications of the Corliss, this form of governor should work very well with a large flywheel. The cylinder would either get a charge of steam which would correspond to the full engine load, and which would, therefore, be expanded and worked in an economical way, or it would get none. This alternation of full load and no load is common in gas engines, and, for distinction, may be called the hit-and-miss method of governing. The only steam engine I know which employs it is the Parsons steam turbine. Of course, the great difficulty is the flywheel, especially in a slow-speed engine. If working at a tenth of its load it gets steam only every tenth revolution and the flywheel must carry it round for nine. As high speeds are gradually coming in it may be worth while to keep this method of governing in mind, as it is most economical of steam, and as there is no time lag in the governor there is no hunting.

Returning to the isochronous governor, the obvious method of overcoming the friction or weight of valve gear is to use some relay—to use a convenient electrical expression. The governor does not then act directly on the valve gear, but puts some screw or other mechanism into gear, which works the expansion or throttle valve. Willans used a water relay. The governor worked a minute water-valve, controlling a cylinder which worked the throttle valve. Such an arrangement can be made very accurate, as a very small movement of the governor, opposed by a very slight force, can be made to work the most obstinate valve gear. But we have at once danger from hunting, as there is considerable time lag in the governor. Suppose the load is suddenly decreased, the engine speeds up and the governor begins to increase the expansion, but effects this slowly, and by the time the valves are right for the reduced load the engine is much above speed. The governor, therefore, goes on reducing the steam until the engine has far too little. It therefore slows down again. But the governor continues reducing the steam until the engine is slowed down to its normal speed. By that time the engine has far too little steam, so it goes on falling in speed. The governor then begins to turn on steam again, but it does it so slowly that the engine has fallen far below speed before the normal steam supply is given, and the governor goes on turning up steam till the engine arrives at its normal speed, when it has far too much steam and is again rapidly increasing in speed. This cycle of operations is repeated over and over again. It depends on the lag of the governor, the flywheel and the load whether the hunting is temporary, so that the variations of speed are less and less every time, or permanent, in which case the engine alternates between no steam and, perhaps, full supply. An engine which hunts permanently at very light loads often works perfectly over half-load.

An ordinary governor is thus apt to be insensitive and to allow the speed to vary with the load if designed not to hunt; and if arranged to work a relay, hunting results. An isochronous governor with a dashpot has, of course, a time lag too.

It is easy to make a governor which combines the advantages of both systems and avoids the drawbacks.

A governor made by Messrs. Weyher, Richemond & Co., of Pontin, may be cited as a good example. It is not isochronous and it works directly on the steam control. I may mention that even in small engines the French arrange the valve gear so that it is easily controlled. The variable detent is very common. In addition to working the steam control direct, any movement of the balls from the normal position puts a screw gear into motion, which slowly alters the intermediate gear, so that the engine finally runs at the normal speed whatever the load is. It is unnecessary to describe the particular gear employed; a typical case may be imagined. Suppose the expansion link is in connection with the middle of a lever, and the governor with one end, the other being fixed; an increase of speed raises the first-mentioned end of the lever and the middle, and you have an ordinary non-isochronous governor which gives a higher speed at light loads. Suppose, however, that any rise of the first-stated end of the lever sets a train to work which slowly raises the other end, it will go on till the governor is in its normal position. We thus get a governor which does not hunt and gives the same speed at all loads. If the valve gear is heavy or stiff the governor may work one end of the lever by means of a relay, but it must be a following relay, such as those employed in steam-steering gear, so that the extent, as well as the direction of the movement of the governor end of the lever is controlled by the position of the governor, and this gear should act as promptly as possible to avoid hunting. The other, or relay gear, then works slowly. In such a governor it will be seen that the first-mentioned end of the lever eventually comes to its normal position in all cases, and only moves to counteract sudden variations of speed. The real control is effected by the slow-moving relay moving the other end.

Instead of using one governor a pair may be employed, one of which works direct on the valve gear and the other by means of a slow-working relay. This method does not seem so simple as using a simple governor to do both.

These matters must have been worked out thoroughly by many engineers, and they appear so simple that one almost feels ashamed to bring them forward here, but in looking the matter up I find the governor is generally treated by itself without reference to the engine. I have, therefore, thought it might be worth while to bring this subject forward, and trust you will bear with me for having put it in such a very elementary manner.

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[*] Paper presented at the Oxford meeting of the British Association.

[†] Royal Institution, March 15, 1878.

[*] Proceedings Inst. Civil Engineers, Vol. CXIII., p. 194.

The Recent Accidents Occasioned by High-Tension Currents.*

BY M. G. CLAUDE.

I recently drew attention to the danger to human life entailed by the intervention of capacity in the canalizations for high tension alternating currents. With the object of lessening the number or the gravity of the accidents resulting from this cause, I have proposed a very simple arrangement, based on the reciprocal actions of self-induction and capacity, and of which I hope soon to be in a position to give the practical results. The sad accident at Cannes has just furnished a fresh proof of these dangers, and has provided the opponents of the alternating currents with fresh arguments, which they have not failed to seize upon. For my part I merely see in it one more demonstration—unfortunately too clear—of the importance of discovering a perfect solution of the problem that I have been studying.

I wish in this article to discuss, on rather a different plan to that ordinarily followed, this question of accidents occasioned by high tensions in general, both in the case of continuous and alternating currents. There is a great deal to be said, and perhaps to be done, with regard to this subject in many ways, and the study of precautions for the protection of human life is of sufficient importance for me to be excused if I dwell upon it.

Is it not, for instance, astonishing that up to the present time no regulations have been drawn up with the object of indicating the various measures to be adopted in the case of such accidents, measures which it is indispensable should be known if life is to be saved? We are sufficiently accustomed to the interference of the Government in all our affairs for official intervention in this matter not to seem uncalled for; it would have the effect of preventing the negligence or indifference of those responsible, and would be less open to objections than restrictions imposed when concessions of electrical energy are granted.

We know—M. D'Arsonval's researches have irrefutably shown—that in most cases high tension currents act by paralyzing the functions of the heart and lungs, so that a person that has received a shock from them may be compared to a person apparently dead from drowning. The same treatment should therefore be applied to him, and this consists chiefly in using methods calculated to restore respiration, amongst which the rythmic tugging of the tongue, advised by Dr. Laborde, seems to have given the best results.

It might have been supposed that this similarity to the cases that are provided for by humane societies would have led someone to think of the placards posted up by these societies wherever there is any danger. This plan, by making public the knowledge necessary in these cases, has produced sufficiently good results for us to admit that the best thing to do in parallel cases is to follow their example.

This has not, however, been done. Up to the present it has been left to those witnessing an accident to do what seems best under the circumstances, which is a most deplorable state of affairs, for however anxious they may be to render assistance, the necessary knowledge is apt to fail many persons at the very moment when they have most need of it.

It follows, then, that not only do those interested in this matter do nothing to provide for persons being restored to life after an accident of this kind; that not only must the death of the greater number of the victims of electricity be imputed to this absence of instructions, but also that those interested neglect to take the most elementary precautions for themselves.

With electricity, as in other cases, the *rôle* of rescuer is attended with a certain amount of danger, to obviate which certain rules should be followed and certain precautions taken; if the work of rescue is undertaken by an inexperienced person, or by one who has lost his presence of mind, it may be as dangerous for that person as if he threw himself into the water to serve another in danger of drowning.

I wish to call particular attention to this point, which has, perhaps, received too little notice up to the present. A recent accident, which will no doubt lay the foundation for more definite instructions with regard to this matter, will confirm what I have said. I will briefly relate the occurrence.

Two workmen, belonging to the Compagnie du Nord, were working in the neighborhood of a very high tension main, when a chance contact was produced between one of the workmen and the cables belonging to this canalization. He remained clinging to the cables, as is unfortunately the rule in such cases, and his companion went to his help and tried to free him; but, receiving a shock in his turn, he was thrown to the bottom of the ladder which he had mounted. This was, perhaps, fortunate for him, notwithstanding the fact that his leg was broken, for, without this fall, the asphyxia caused by the current would have done its work. As to the principal victim, who was treated by Messrs. Leblanc and Picon, who were, fortunately for him, witnesses of the accident, we know what a splendid confirmation of M. D'Arsonval's doctrines resulted from his treatment—a confirmation, moreover, that we cannot note without a certain degree of sadness, for it clearly shows that the greater number of the victims of shocks far less severe and far less prolonged might easily have been restored to life but for the ignorance of those by whom they were surrounded.

I will also briefly refer to the accident that occurred a few months ago in the Rue Saint Augustin at one of the sub-stations of the Popp sector, and which resulted in the death of an electrician. The unfortunate man, through a train of circumstances that we have not space to enter into here, had fallen in such a manner that one of his feet was in contact with a battery of accumulators that were being charged by the high tension system, whilst his bleeding head rested on the ground in a pool of acidulated water. One of his fellow-workmen drew him away, dead, without any accident to himself, but it was certainly quite by chance, as I shall presently show, that he did not receive a shock in his turn, and that there were not, as in the preceding accident, two victims instead of one.

As I have already remarked there are in such cases certain precautions to be taken. It does not do to obey heedlessly the impulse that leads us to rush to the rescue of the person in danger; we should first reflect or we may risk our own life without saving that of the victim. But reflection under such circumstances can hardly be expected from many people, or from many workmen either, for, as a rule, the witnesses of these accidents are workmen; moreover, the fear of a danger to one's self that we do not at the moment fully realize may lead to a certain amount of hesitation, the consequences of which may be fatal.

All this is evident. I did not, however, wish to confine myself to mere assertions, and I therefore endeavored to confirm my opinions, as far as possible, by experiment. Several men employed in electrical work have been asked suddenly and separately what they would do in case of an accident to help the person in danger. They were certainly more able to reflect calmly on what ought to be done in such a case than if an accident had really happened. Nevertheless they all hesitated, and this is not to be wondered at, for the question, which is a very simple one in the case where the accident is supposed to happen at the works, where we have everything at hand, cannot but be embarrassing when we assume that we have nothing in readiness, for instance, if the accident occurs at some point of the canalization, or on the premises of a consumer; but if this hesitation is only natural, it is no less true that, under present conditions, it results almost certainly in the death of the victim.

What is still more serious, the reply given by several of the workmen that were questioned showed that if they really had witnessed an accident they would have most probably taken steps that would have resulted in consequences fatal to themselves.

It seems, therefore, that total ignorance on this subject is the general rule; the accidents that have happened, of which those we have mentioned form only a small fraction, confirm far too conclusively what I have said, and we are therefore justified in urging that it would be doing really useful work in giving those interested the advantage of instructions that they could commit to memory beforehand, shewing what precautions should be observed, pointing out the danger of acting in such and such a manner. These might form the first part of placards—drawn up after the fashion of those of the humane societies—such as I have already suggested.

It should, for instance, be set forth that the first thing to be done when an accident occurs is, of course, to cut off that part of the canalization where it takes place whenever it is possible, i. e., when there is an interrupter near at hand. But this will not very often be the case; it will more probably be necessary to detach the victim himself from that part of the circuit with which he is in contact, being held fast by the paralysis or drawing up of the muscles.

In this case we must remember that, as in the case of a simple contact between one of the cables and the earth, the body of the person who has received the shock forms part of the high tension circuit, that he is subjected, even very near the earth, to potentials that might be dangerous. Under ordinary circumstances, in fact, we know that about half the total resistance of the body is localized in the skin at the part where it is in contact with the earth. We must therefore take care not to touch with bare hands the skin of the person to whom the accident has happened, for we should then receive a current which, although far weaker than that passing through the victim, might still lead to serious consequences. It must not be forgotten that even if we should not receive an appreciable shock at the moment of contact, the danger may be all the greater; if, through the efforts made to detach the body, or through its contraction, its contact with the earth should cease or become less perfect, we should find ourselves suddenly forming part of the circuit, and in great danger in our turn. This is, for instance, what might have happened in the accident in the Rue Saint Augustin. If the workman who ran to the assistance of his comrade, instead of first disengaging his feet from contact with the accumulators, had begun by raising his head, which might have seemed more urgent considering the blood that was flowing from the wound, he would, in his turn, have been traversed by a current capable of killing him.

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* *L'Industrie Electrique.*

We should, therefore, not touch the victim without first protecting the hands with dry rags, or, better still, indiarubber gloves, which form the best safeguard. We might, with a similar object, be led to stand upon an indiarubber mat or on some insulating material; but even if the insulation is perfect, this method is not to be recommended: far from it, the danger incurred may be all the greater, from the fact that we believe ourselves in perfect safety. For instance, it may be necessary to detach the hands of the victim from a cable, or it might seem advisable to raise him from the ground so as to break the circuit, and under such conditions, i.e., well insulated, one would not hesitate, in order to save time, or to have more freedom of action, to use the bare hands, and it might happen that at the moment the circuit was broken one would be in such a position as to receive the current through the arms and lungs. One might also be led to believe—at least, so I found from the examination already mentioned—that if we touch only those parts of the body covered by the clothing we shall run no risk. This, again, is a dangerous mistake; perspiration may make the clothes damp and render them good conductors, especially under the arm-pits, which would be the very part likely to be seized. With an alternating difference of potential of merely 200 volts, and an insulated subject communicating with one of the terminals of the transformer employed, we receive in most cases violent shocks if, when connected with the other terminal, we touch these parts of the body.

It is no less true, however, that the clothes folded into several thicknesses constitute a pretty good insulator, and one that is always available.

Thus, one mode of procedure that might do some good, if an accident should occur where there are no appliances at hand, would be as follows: To take off some garment and make a thick pad with it. By means of this pad to seize the victim, and try to pull him away, after having first, if possible, raised him from the ground, so as to break the circuit and relax the contraction of the muscles. If this cannot be done, another pad should be made with clothes and interposed between the ground and that part of the body of the victim in contact with it. The passage of the current will thus be interrupted, and the necessary respite given for trying more efficacious methods. A more effective precaution still, for really everything depends on the hands being protected, would be to insist that all men employed on high tension circuits should be always provided with a pair of indiarubber gloves.

It will be observed that in all the foregoing remarks I have assumed that the accident occurs between the cable and the earth, which is generally the case. These considerations could very easily be modified to suit the case of a simultaneous contact with both poles.

In short, then, the precautions to be taken under these circumstances are most simple. They would suggest themselves with very little reflection, and it will perhaps seem somewhat unnecessary to repeat them, and to devote some pages to arriving at the conclusion that we must not touch with bare hands a person who is suffering from a shock from a high tension current. But I feel that I cannot too strongly urge the importance of these points; in the first place those interested—workmen and others—are not always capable of even very simple reasoning; moreover, we cannot be surprised if even those who are capable of reasoning should, under such circumstances, lose their presence of mind.

Then the precautions to be observed for preventing as far as possible such serious accidents are so simple that it would be a thousand pities that there should be a moment's hesitation.

We are informed, moreover, that at the request of M. Monmerqué, engineer to the City of Paris, in charge of the Halles Station, the Academy of Medicine, through M. D'Arsonval, will soon fill up the void to which I referred at the commencement of this article with regard to the treatment of people who have received shocks.

The profound experience that the eminent professor possesses with regard to these delicate questions is a sufficient guarantee of the manner in which this instruction will be imparted. If it is confined at first to the high tension systems at Paris, I sincerely trust that it will be sufficiently complete to take into account the dangers that I have described, and the means of avoiding them.

A Suggested Explanation of the Secular Variation of Terrestrial Magnetism.*

BY ARTHUR SCHUSTER, F.R.S.

It is a matter of great importance to ascertain whether we must consider interplanetary space to be a conductor of electricity or not. If there is an appreciable conductivity, the magnetic system of the earth will, owing to its rotation, induce currents which will react on the earth in a twofold manner. There will be, in the first place, a mechanical effect tending to increase the length of the day, and secondly, a magnetic effect tending to displace the magnetic axis. It is the object of this communication to give the results of some numercial calculations referring to the magnitude and nature of these reactions.

The problem is of interest apart from any applications to terrestrial magnetism. Given a magnetic sphere rotating in a conducting medium, what are the mechanical and magnetic forces acting on the sphere in consequence of electric currents induced in the medium?

The mathematical solution is easily obtained from Lamb's equations for currents induced in spherical conductors; and, without entering into any details of calculation, I here state the principal results for the case that the sphere is uniformly magnetized about an axis not coinciding with the axis of rotation.

If the medium is either perfectly conducting or perfectly non-conducting, there will be no mechanical effect tending to stop the rotation of the sphere; but for all finite conductivities there will be a couple opposing the rotation, which is a maximum for a certain specific resistance of the medium.

If the radius of the sphere is R, the angular velocity ω, the specific resistance ρ producing the maximum retardation is given by the relation

$$\rho = 1{\cdot}4\, R^2\, \omega,$$

where the numerical factor is approximate only.

$$\text{For the earth : } R = 6{\cdot}4 \times 10^8 \quad \omega = 7{\cdot}27 \times 10^{-5}$$

$$\rho = 4{\cdot}7 \times 10^{13}.$$

The resistance indicated by this number is such that if 4·7 volts were applied to the two sides of a plate having a thickness of one centimeter there would be a current of 10^{-4} amperes per square centimeter. I do not know of any facts which would make such a conductivity an impossible one, consistently with the extreme tenuity of matter which we know must exist in space. The next point to consider is the actual value of the maximum retarding couple. In C. G. S. units, and for a sphere having the same size and magnetic moment of the earth, it is $1{\cdot}9 \times 10^{24}$. If this couple was to act continuously it would diminish the earth's rotational velocity to the extent of one second per day in 14,000 years. Early records of solar eclipses show that the earth as a timekeeper has lost time, but authorities do not agree as to how much. Two causes tending to alter the length of the day have hitherto been considered, tidal friction tending to retard it and the contraction of the earth tending to increase it. To this we must now add a possible retardation due to the conductivity of the medium.

The maximum magnetic couple calculated above is about six times that given by George Darwin for the effect of tidal friction, and it would by itself have produced a very marked effect in historical times. But, as far as I know, we have no data giving us any information as to the allowable contraction of the earth. If the diminution of the earth's radius amounts to a foot a century, it would counterbalance the maximum effect which the magnetic couple could possibly have. It is, of course, very improbable that the conductivity of space is just that required for the maximum effect. If the conductivity is 100 times less, the couple produced would be equal to the tenth part of the maximum couple, and such a couple would be impossible to separate at present from the other effects, tending to alter the length of the day. There is, therefore, a very large range of electric conductivity within which that of space may lie without an appreciable effect on the length of the day being produced in historical times.

Turning our attention next to the magnetic reactions, we find that these will displace the magnetic axis towards the geographical pole and round it from east to west. If the earth behaved like a steel sphere, not subjected to any shocks or changes of temperature, a certain displacement would take place once for all, but no rotation such as is required to produce the secular variation. The constantly-renewed displacement of the magnetic axis, if it is due to the suggested cause, must be produced by a continuous change inside the earth. A possible explanation suggests itself in the secular cooling of the earth, owing to which more and more of its iron becomes susceptible to magnetization. This virgin iron will be free to adjust its magnetic axis to the magnetic forces acting on it, and a continuous displacement of the axis must result. It must be acknowledged, however, that even taking account of this possibility it is difficult to see how a rotation of the axis can be kept up for several revolutions. Some light might be thrown on the question by an experimental investigation to discover a possible effect of great pressure on the temperature at which iron loses its magnetic properties.

If the secular variation is connected with the conductivity of space, everything that affects the latter must affect the rate of progress of the variation. I have on several occasions expressed an opinion that the curious effect on the earth of an increased sun-spot activity may be due to a greater electric conductivity at times of many sun-spots. When the above explanation occurred to me two years ago I looked up the records to see whether that secular variation seemed to proceed more rapidly when the sun-spot activity was great. I found, indeed, some remarkable coincidence between the years in which the secular variation was great and marked sun-spot years; but on the whole the parallelism of the two phenomena did not seem sufficient to draw public attention to the fact. Recently, however, I found the same coincidence noticed independently (I believe by Liznar). Should it prove established on further investigation, the theory of the secular variation suggested above would deserve attention. Whether there are any appreciable magnetic effects due to electric currents outside the earth may, of course, be established by an analysis of the magnetic forces on the surface of the earth. I understand that A.

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* Paper presented at the Oxford meeting of the British Association.

Schmidt and Neumayer have already made much progress with such an analysis, and I am preparing an independent calculation with special reference to the outside forces.

The results of this investigation may be stated thus:

(1) The mechanical reactions on the earth of currents induced in space, assumed to be a conductor of electricity, by the rotation of its magnetic system are insufficient to produce an appreciable lengthening of the day in historical times, unless the conductivity lies within certain narrow limits. The absence of any marked effect cannot, therefore, be brought forward as an argument against the conductivity of space.

(2) The magnetic reactions of the same current, taken in conjunction with the secular cooling of masses of iron inside the earth, tend to produce a displacement which in kind is the same as that actually observed in the secular variation. But whether quantitatively the variation can be explained in this way is very doubtful.

An Audible Railway Signal.

An electrical block system for railways, which gives a danger signal by ringing a bell on the locomotive, has been exhibited in Buffalo by Mr. Cornell, its inventor, who has organized a company in Philadelphia to exploit the system.

The inventor states that the system will give an alarm to the engineer or fireman of a moving train when approaching a standing or moving car or train on the same tracks, and will give an audible notice of an occupied grade crossing, an open switch or drawbridge, a car projecting on a main track, a broken train, washouts, etc.

One of the rails is made a continuous conductor and the other is divided into sections or blocks and provided with electrical connections which overlap from one block to the other. The engine is equipped with feelers which run on electric contact plates placed between the rails so arranged that the engineer is kept advised of the exact condition of the tracks in front of his engine. Mr. Cornell says that this system can be put in for $250 a mile.

An Illuminated Orange.

An electrical experiment of some interest is described in *La Nature*—the illumination of an orange. Upon an insulated support there is placed an orange, into whose poles are inserted movable needles which, through the intermedium of sleeves, are carried by glass standards. One of the needles communicates with the external armature of a stong battery of Leyden jars charged by means of a Holtz machine. After a sufficient quantity of electricity has been accumulated, one of the arms of an exciter is applied to the needle, while the other is placed near the interior pole of the jars. A strong spark bursts forth, and at the same time the orange becomes illuminated with a bright red light that gives it the aspect of a globe of fire.

If, in a repetition of the experiment, the orange be so turned that its axis shall be at right angles with the direction of the needles, the discharge will pass around it without illuminating it.

This latter phenomenon is explained by the difference of resistances of the fibers in the various directions. It is not an isolated one, but, on the contrary, constitutes a general property of ligneous bodies.

It appears probable that the light is produced in the interior of the fruit and entirely traverses the skin, which thus shows itself more transparent at the level of the spark than would have been believed at first sight.

The discharges in the direction of the axis damage the orange but slightly. On the contrary, when, by exception, a spark traverses the fruit in a perpendicular direction, it tears it in pieces and destroys it. The experiment succeeds nearly as well with other fruits, which become illuminated with various tints.

On the Construction of Delicate Galvanometers.

BY PROF. A. SCHUSTER.

Maxwell has shown how a galvanometer must be wound in order to produce the maximum magnetic field for a given resistance. The present communication is intended to show what the advantage gained would be if the winding which is theoretically best could be adopted. Assuming the cavity in which the magnet is suspended to be cylindrical, the sensitiveness of the galvanometer will vary with the square root of the resistance, and inversely as the square root of the radius of the cavity. The smallest angle which can be read without making the system astatic, will also depend on the diameter of the mirror—a point which has been neglected in the construction of some recent galvanometers. Taking the resistance of the galvanometer to be one ohm, the diameter of the cylindrical cavity to be one centimeter, and the width of the reflecting mirror to be also one centimeter, the smallest current which a galvanometer will show with a horizontal force of .17 is, under different conditions, as follows:

If wound in the theoretical, but possible, way, 1.60×10^{-8} amperes;

If wound on a bobbin of rectangular section of the best dimensions, the wire being uniform in each layer, but changing from layer to layer so as to give the best possible results, 2.00×10^{-8} amperes;

If wound on a bobbin of rectangular section with uniform wire, the dimensions of the bobbin being the most favorable, 2.14×10^{-8} amperes.

The advantage gained by having the winding in the way which is theoretically the best is, therefore, not very marked.

The Thermogen.

A new invention, called by its inventor the thermogen, consists of a quilt containing a coil of wire bent in the fashion of a gridiron, inclosed in insulating and non-conducting material, and imbedded in cotton, wool or other soft substance, with a silk or woolen covering. The resistance offered by the coil to the flow of an electric current through the wires produces heat in the same way that heat and eventually light are produced in the filament of a glow lamp. A uniform temperature of about 150 degrees Fahrenheit is thus maintained, but in the event of the temperature rising beyond that point from increase of pressure in the electric mains, a fuse instantly melts and automatically shuts off the current. The quilt may be readily attached to ordinary incandescent lamp terminals. In describing this device the London *Lancet* says the most important medical use of such an invention would be on the operating table, where, in lengthened operations or in those attended with hemorrhage, where artificial means to sustain the patient's temperature are required, blankets and hot water are a decided nuisance. In such cases the quilt would be invaluable as a soft, dry, warm and convenient covering. Again, in cases of chronic rheumatism, lumbago or senile slowness of circulation, such an appliance would be useful. The thermogen is now receiving trial at several large English hospitals.

A Telegraph System for Japan.

The Japanese Consul at New York has been negotiating with Mr. A. W. Cohen for the building of a telegraph line in Japan. Mr. Cohen, who was formerly electrician for the Erie Railroad, has just resigned that position and will shortly start for Japan with a corps of telegraphers and linemen under a year's contract to put up the new line.

Photographic Records of Telephone Vibrations.

A correspondent of the Manchester (Eng.) *Guardian* gives the following account of the method of obtaining a photographic record of telephone vibrations corresponding to different sounds: "The problem has been attacked in a new way by Mr. G. J. Burch, who has succeeded in making an instrument by means of which the E. M. F. of the currents generated by speaking into a telephone can be recorded photographically. These currents are too rapid to affect an ordinary galvanometer individually, and inasmuch as they flow alternately in opposite directions their combined effect is nil. But it seems that the capillary electrometer, invented some years ago by Lippmann, has been brought to such perfection in Oxford that electrical changes occurring hundreds, and even thousands, of times in a second can be recorded by its means. The instrument consists of two glass tubes, one drawn out to a fine point, and the other bent into the shape of the letter V. The latter is about half filled with mercury, and contains in one limb a few drops of dilute sulphuric acid. Mercury is poured into the other tube, and is forced, partly by its weight, and partly by compressed air, into the narrow part of it, where it hangs balanced, as it were, by the force of capillarity. This tube is fixed so that its point dips into the acid in the V-tube. Platinum wires dipping into the mercury in either tube serve to connect the instrument with the circuit of the telephone. The smallest change in the electrical condition of the circuit instantly disturbs the balance of the capillary forces, and the end of the mercury column is driven up or down, according as the pressure of the current is towards it or away from it. These movements occur with a rapidity that the eye is unable to follow, and the instrument is perfectly dead-beat in its action—i.e., there is nothing at all resembling the oscillations of the needle which render observations with a sensitive galvanometer so serious. In order to record these movements recourse is had to photography. The magnified image of the capillary tube is projected on to a screen in which is a narrow slit. Behind the slit a sensitized plate is made to pass with a perfectly regular motion, any rise or fall of the mercury column being recorded as a projection or a notch on the edge of its shadow. This method was introduced by Prof. Burdon Sanderson. The apparatus now employed was invented by Mr. Burch. The first photograph shown was taken seven years ago. The electrometer was connected with a telephone, near which a whistle was blown. The currents generated were so intense as to cause electrolysis and it was evident that the movements of the electrometer had been too rapid to be properly recorded on the photograph. This led to the construction of the present apparatus, in which the plate can be made to travel at any desired rate from 6 inches to 6 feet per second. The next illustration was obtained by singing a falsetto note near the telephone, the electrometer having responded to the currents generated by each vibration to the number of 650 per second. From this result it was evident that the apparatus might be used for studying the sounds of the human voice in speech. The syllables 'pop-pop-pop-pop' and 'dod-od-od-od,' spoken during the passage of a plate, produced results easily distinguishable from each other and evidently characteristic of these consonants. The vowels 'a' and 'e' formed the subject of the next two photographs, and the last represented the buzzing sound of 'Z-z-z-z.' This gave a very irregular curve, and Mr. Burch stated that with the lens fine serrations could be distinguished which corresponded to from 2,500 to 3,000 double vibrations per second."

Current Items.

The Hartford (Conn.) *Courant* says: "The newest electrical motor is a locomotive engine which develops power by turning a current of electricity into ring magnets which are placed together so as to form the shell of a long cylinder in which a soft iron piston is the armature. The current being turned into these rings, one after the other, the piston is drawn forward; when it reaches the end of the cylinder the operation is reversed—and there you have a reciprocating motion engine. The least the inventor talks of is 160 miles an hour."

H. Steinman in contradicting a statement in the Seattle *Intelligencer* respecting the operation of the first commercial electric motor, says: "Messrs. Siemens & Halske, of Berlin, Germany, built and operated the first electric motor line, running between railroad station Liehterfelde and the Central Radett Academy station, of the same place, about one and a half miles in length, and which was opened for public service late in the fall of 1880, the undersigned being a witness of the opening ceremonies. In 1881 and 1882 several other lines were built in Germany and Ireland, and in 1883 the first in the United States."

In Chemnitz, Saxony, the method adopted for stringing wires for the overhead trolley system does away with poles. Ornamental rosettes are fastened into the woodwork or walls of houses, and from these project hooks to which wires are attached. Owners of houses without exception preferred to allow the use of their houses free rather than have posts on the sidewalk. The system has now been in operation for several months, and has proved satisfactory and successful. The gauge of the road is narrower than in America, but the cars keep the track and run as rapidly and smoothly as in the United States. In the heart of the city they run 220 yards per minute, and in the suburbs 330 yards per minute. The cars have no conductors. The motorman is the only person on board who represents the company. Fare boxes are attached to both ends of the car, so there is no such excuse offered as "difficulty in getting forward."

The Mayfield breaker of the Hillside Coal and Iron Company, in Pennsylvania, is said to be one of the most complete mining plants and largest in the world, and is owned by the Erie Railway Company. Recently electric plants have been placed in the mines for lighting them and for power to move the cars and elevate the coal, doing away entirely with mule power. The miners are greatly pleased with the new order of things, as it enables them to accomplish more and with greater ease than when working with miners' lamps, while it greatly lessens the danger of explosion. It is stated that a miner can now load seven of the cars used in a mine with the new facilities that electricity affords as quickly as he could three with the mule power and the miners' lamp.

At Dellwood, on the banks of the White Bear Lake, some fifteen miles from St. Paul, Minn., is a unique electrical railroad—the smallest in the world. It runs between the railway station and the summer home of a St. Paul banker, who built and equipped it for the amusement and instruction of his son, a bright lad of 7 years, who acts as motorman, conductor and brakeman with all the dignity and capability of a veteran in the service. The length of the road is a trifle over a tenth of a mile, and the equipment consists of a motor car and two trailers, each car being 5 feet long by 2 feet wide. The gauge of the road is 14 inches, the rail being regular T rail, 24 pounds to the yard. Instead of the overhead trolley, the third rail system is used, the third "rail" being a flat iron strip $\frac{1}{8}$ x 1 inch, nailed on a wooden strip between the two rails. At the end of the line is a neat little power-house, provided with engine, generator and switchboard, as well as a fully equipped machine shop. The engine is a 2 horse-power petroleum engine and is belted to a 2 horse-power compound wound generator.

M. Bertheton, a French chemist, has suggested as a subject for the attention of the next generation of engineers the substitution of the heat of the sun or the earth's central heat as a source of energy for that derived from coal. The sinking of a shaft from 10,000 to 12,000 feet deep is not beyond the power of modern, and especially of future engineering. At such a depth water would be found with a temperature of 176 to 212 degrees, which would develop enough power for any number of machines. This power would be available in any part of the globe, and many thousands of years would pass away before this store of energy would suffer an appreciable diminution.

A correspondent of the Pittsburg *Dispatch* supplies the following information in regard to the telegraph facilities enjoyed by Japan, which give that nation an important advantage over China in the Corean imbroglio. "It is interesting to note," he says, "the important part played by electrical applications in the war now being waged between China and Japan. The Japanese especially are quick to turn to account any advantage offered by scientific appliances, and in Corea they have materially strengthened their hands by taking possession of the lines and stations of the telegraph service. Their men are trained in construction as well as in actual manipulation, and can be trusted to keep the lines in working order as long as they retain control. The Mikado's people have taken very kindly to the telegraph since its introduction in 1870. Their first installation of a couple of short lines, about 40 miles long altogether, speedily grew into 4,000 miles, and now the wires devoted to the service measure close on 26,000 miles, including several submarine cables of various lengths, one of the longest being that connecting Nipon (the main island) with Tsu-shima, the large island midway between Japan and Corea, a position which, as may be readily imagined, is just now of the utmost strategical importance. So well, indeed, have these clever copyists appropriated and utilized the telegraphic developments of Western civilization, that there is now hardly a point on the coast more than a few hours' distant from a telegraph office. In the matter of field telegraphy, too, the Japanese are adepts, their portable instruments, etc., being modeled upon apparatus which they have imported from Europe. The posts are made in sections, with spiked bases to stick in the soil, and the wire runs out from reels on light hand-barrows."

La Lumiere Electrique.

One of our most valuable French contemporaries, *La Lumière Electrique*, has been forced through financial difficulties to suspend publication pending its reorganization. The following notice has been sent out by the publisher:

"Founded on April 15, 1879, *La Lumière Electrique*, a universal journal of electricity, has been for fifteen years the most complete and authentic organ of the science to which it was devoted. It has not hesitated to make any sacrifices to insure its utility, and each year it has resulted in an average loss to its proprietor of more than 70,000 francs, and at the present moment the journal is in difficulties. Two solutions have been considered by the managers: (1) To increase the rate of subscription, and to open the columns of the paper to commercial advertisements; (2) to suspend the publication for a sufficient period to permit of financial reconstruction. The first solution was immediately discarded. *La Lumière Electrique* has never sought pecuniary gain, and it will remain a journal of pure science, and a stranger to all commercial promiscuity. The second solution has therefore been adopted, and it is hoped that subscribers, remembering the past, will be faithful to it in the future and that they will accept patiently this momentary stoppage. Those subscribers who do not adhere to this proposal will be good enough to communicate with counsel, M. Francis I. Delasalle, Advocate in the Civil Tribunal of the Seine, 19 Rue d'Alger, Paris."

ANODE.

I am dirty and dull,
I am frequently full,
(Yet others are Fuller,) I'm blue and I'm gloomy;
In circuit I'm wired,
In candor, I'm tired,
Though oft the inspector returns to renew me.

When the button is pressed
I accomplish the rest;
(I'm sure you admire that original pun,)
Through copper and zinc,
Quite as quick as a wink,
The lightning shoots forth and the business is done.

I never may shirk
My arduous work,
Though shelved for my life in full many a town;
From friends insulated,
I am, as I've stated,
Though often set up, nearly always cast down.

To unburden my mind
I will send this when signed,
(At nitrates, of course,) to the editor wise;
Wiser still he'll appear,
And will plant me, I fear,
Among "Current Topics"—(That phrase I despise).

They say—(Is it so?)—
That the big dynamo
Is daily supplanting the small batteree;
That the day will be cold—
(That is slang, I am told,)—
For Fuller, Grove, Bunsen, Leclanche and Smee.

Let it come when it may,
I will welcome the day,
For I'm tired of it all, as I said when I led off:
No phate can be worse
Than the sulphate I curse,
And my name shall be written as Dennis, instead of

his
Daniell + Battery.
mark.

Legal Notes.

Mr. Grambs, local manager of the Northwest General Electric Company, has been appointed receiver of the Grant Street Electric Railway of Seattle, Wash. Fred E. Sander, who is owner of the road, is reported by a Seattle paper to have said that the line had been making a net profit of $1,000 a month, all of which was being handled by one of Mr. Grambs's agents in the company's office. He was under the impression that the electric company had brought the suit, but said that he was confident that he would be able to show good cause soon for having the appointment of a receiver vacated.

During the last session of the Connecticut Legislature charters were granted to several companies for electric railways whose routes would run parallel to those of established steam roads. The New York and New England Railroad Company recently appealed to the Superior Court asking its disapproval of one of these paralleling lines, and Judge Fenn, of that court, has refused the appeal, and finds that the construction of the projected line is required in the interests of public convenience and necessity. As there is no provision for an appeal from the decision of the court, this seems to settle the question of electric roads paralleling steam roads in Connecticut.

J. D. Davis, of Altoona, has been appointed receiver of the Robinson Machine Company, manufacturers of trolley cars and electrical goods at Bellwood, Pa., by Judge Bell, of the Blair County Court. Harry A. Gardner, the defaulting cashier of the closed Second National Bank of Altoona, was the controlling power in this company, and the funds of the bank were appropriated to float the concern.

James F. McLaughlin has filed a bill in equity in Court No. 1, Philadelphia, asking for the appointment of a receiver for the Standard Electric Company of that city. McLaughlin, who is an inventor, was one of the partners of the concern and alleges that the accounts have not been properly kept.

R. W. Hill, of Manchester, England, has devised an appliance for backyard fences, etc., which he describes as "an electrical automatic annihilator, reckoner, and alarm for cats, rats, and mice."

WHAT GOES ON IN CHICAGO.

Mr. P. S. Bemis, who for some time misrepresented the interests of the Peckham Truck Company in this and other cities, is at present confined in the county jail on charges of forgery and swindling.

Mr. W. J. Clarke, general manager of the General Electric railway department, has been on duty at the Chicago office for about a week in the absence of Mr. Bailey.

Lieut. F. B. Badt, of the Siemens & Halske Company, has just returned from an Eastern trip. The Siemens & Halske Company are now booking orders for apparatus for delivery in sixty days, their new works being in full blast. They are better equipped than before the fire for turning out even the largest apparatus at short notice. The probabilities are that this company will soon be in the field as builders of complete equipments for electric roads—including cars, trucks, motors, generators, etc.

Mr. J. Holt Gates has averaged for some time past the sale of one machine a day of the Mather Electric Company's apparatus.

The Metropolitan Electric Company report their business for the month of August as the largest for any month in the company's history.

The failure of Mr. Myron A. Knapp is universally regretted in Chicago, where Mr. Knapp had made friends of everybody in the business. He was recognized as a fair competitor, and the failure is looked upon as a misfortune to the local trade.

The Sunbeam Incandescent Lamp Company are preparing to enter the field, better equipped than ever, before the close of the year.

Mr. Fred Degenhart, in charge of the Western office of the Standard Underground Cable Company, reports the closing of several large contracts for his company within the past few weeks.

The largest contract for railway apparatus which has been closed in the West for some time was secured last week by the Westinghouse Co. from the Chicago City Railway Co. The initial order was for eight 700 H. P. generators and seventy car equipments. The next large job on foot is for the Lake Street line of the Yerkes system, and it is believed the Westinghouse Company will also secure the motor contract; the generators are already being built by Siemens & Halske.

Mr. Joseph M. Hill, of the Columbia Lamp Company, is doing a good business for his company, with prospects of a large increase this fall.

Mr. George K. Hooper, who looks after the interests of the Abendroth & Root Company in the West, reports that he has found in his own business little evidence of hard times.

Mr. Babcock, of the Falls Rivet and Machine Company, of Cuyahoga, O., has been in Chicago for a few days.

Mr. F. C. Randall, who took charge of the Western business of the Brill Company some months ago, has repeated his Eastern successes in this district. The last contract closed was at Akron, Ohio.

Mr. Francis E. Donohoe, representing the American Electrical Works, who sprained his leg at the recent clambake during a flight of oratory, has recovered, and is again hustling for business.

Mr. D. P. Perry, of the Standard Electric Company, has been confined to his house for some weeks by a severe throat trouble. The Standard factory is working full time, the company having secured this season, among other nice business, contracts for municipal plants at Logansport, Ind., Kalamazoo, Mich., and Newton, Ill.

Mr. J. H. Cooke, of the Buckeye Electric Company's Western office, is taking advantage of the favorable position occupied by Buckeye lamps, and is doing a good business.

The Wallace Electric Company, whose line of specialties includes Habirshaw wire and Electric Construction and Supply Company's lamps, report pleasing activity in their various departments.

There will be a goodly delegation from Chicago at the Atlanta Convention in October.

Mr. John L. Martin has retired from the firm of Horne & Martin. It is probable that Mr. Horne will associate himself with Mr. Ide in the management of the National Electric Company of Eau Claire.

Mr. John Shea, of the Munson Belting Company, is spending a few days in Chicago.

The Central Electric Company, recognized as the largest supply house in the country, report a splendid business for the season just closed in Lundell fan motor outfits. They are preparing for a lively campaign this fall.

New England Notes.

The Charlestown Navy Yard, Boston, where considerable Government work is now being done, is to be equipped with an extensive lighting plant. The Federal authorities have made an appropriation of nearly $16,000 for that purpose and work on the new plant will commence in a few days. The generating plant will be erected in the great machine shop and lamp circuits run to any building, including workshops, offices, officers' quarters, the marine barracks and the yards. Feed wires will also be run to the training ship Wabash, which lies at anchor in the harbor near by, and she will be thoroughly lighted by means of the electric current.

In the financial column of a Boston daily there appeared a few days ago the statement that the General Electric Company has unfulfilled orders on its books of the gross value of $2,500,000. No statement is made as to how this amount of business compares with the average state of the company's order book, and since the public have come to know and understand the motive which prompts to the publication of such statements very little reliance is placed upon them. It is just in line with the old time policy which has brought ruin and disaster on the Trust, yet the misguided managers seem incapable of realizing the mischief such policy is doing them.

All the employees of the Marblehead Division of the Lynn and Boston Railroad Company had a big picnic, lasting all day, at Naugus Head, last Wednesday. As their distinguished guests they entertained several superintendents of neighboring roads, and presented the foreman of their own car house with a gold ring and watch chain.

Mr. R. T. McDonald, the well-known head of the Fort Wayne Electric Corporation of Fort Wayne, Ind., was in Boston a few days ago conferring with Mr. E. I. Garfield, who now has charge of the New England business with a splendid office in Federal street, Boston. As is well known, the Fort Wayne people have now the sole and exclusive ownership of some most valuable electric railway patents, and with the popular and successful men representing their interests there is no reason why the company should not, ere long, be doing a large and profitable business in this district. Inquiries are being received daily, and the outlook is more than promising.

It is within the range of possibility that by next summer the whole of the North Shore marine resorts, beginning at Winthrop and extending to Gloucester and beyond, will be connected by electric railways The system will be practically a continuation of the West End Railroad in Boston, though owned by a different and rich corporation, and everybody is sanguine that the charming shore resorts through which it will pass will enjoy such a boom and growth as they have never had before.

An accident occurred in Providence, R. I., on Labor Day—an electric car colliding with a buggy in which were two gentlemen. The two were hurt somewhat by the mishap and at once proceeded to enter suit against the Union Traction Company for $20,000 and $1,000 respectively. Writs were served on the company the next day.

It is reported on good authority that in view of the fact that the proposed elevated railway for Boston will be built between Tremont and Washington streets, and parallel with those busy thoroughfares, it will be necessary for the Edison Electric Illuminating Company to vacate its Head Place central station and remove to its large and handsome station recently built on Liverpool Wharf, Atlantic avenue. The latter is already regarded as one of the finest equipped stations in the world, and should it be enlarged by reason of these prospective changes, it will then rank as one of the foremost, if not the foremost, central stations in existence.

Canadian Notes.

Our Toronto correspondent sends us the following items :

Amherstburg is getting an incandescent system of electric lighting.

Messrs. Douglass, of Philadelphia, and Clerque, of Bangor, Maine, visited the Kakabeka Falls, near Port Arthur, last week, and expressed themselves as much impressed with the water power there undeveloped. Messrs. John Bogart, chief engineer of the Niagara Power Company of New York, and A.P. Bolter, also a distinguished New York engineer, have likewise recently made an inspection of the Falls. It is understood there is a scheme on foot to erect one of the largest pulp and paper mills in America there if the conditions are found suitable.

The Kingston Street Railway Company are agitating for double tracks on Princess street, but property-owners are objecting. Various belt lines and extensions are on the tapis.

The London Street Railway Company has carried the judgment of the Court of Appeals in favor of the city of London, and preventing the company from putting double tracks on Dundas street, to the Supreme Court.

The electric railway between Galt and Preston has so far proved a great success. The expenses of running the line are about $25 per day, and the gross receipts now average something over $75 per day.

The council of Perth have granted a bonus of $5,000 for an electric railway between Perth and Lanark.

General News.

What is Going on in the Electrical World.

Opelika, Ala.—The dummy line now being built between Auburn and Opelika will, it is said, as soon as the whole line is completed be changed into an electric line.

Syracuse, N. Y.—The People's Railway line will be equipped with electricity at once. The idea of operating the line by the storage battery has been abandoned for the present.

St. Charles, Mo.--The franchise for an incandescent electric light plant to be operated in this place by Williams & McGee of Montgomery City has been ratified by the citizens at a special election.

Albany, N. Y.—The State Board of Railroad Commissioners has granted the application of the Cortland and Homer Street Surface Railroad Company for permission to use electric power in operating its road.

Doylestown, Pa.—The engineers who have been surveying the route of the Bristol and Newtown trolley road through Langhorne have finished their work, and it is stated that the road is to be built at once.

Chillicothe, O.—The Chillicothe Electric Railway and Light Company's plant has been sold at sheriff's sale to the General Electric Company for $20,000. The railway will now be improved and extended.

St. Louis.—The Citizens' Railway Company is changing its Franklin avenue cable line into an electric system. With a proposed extension of the line to De Hodiamont avenue, there will be thirteen miles of tracks, including the return.

Media, Pa.—The route for the Media, Middletown, Aston and Chester trolley road is being surveyed and the company is making preparations to construct the line. The new road will open up a valuable part of Delaware County.

Pelhamville, N. Y.—The people of Pelhamville are circulating a petition to be sent to the Union Railroad Company of Mount Vernon, requesting that a line be constructed through the village which will connect Pelhamville with Mount Vernon and New Rochelle.

Niagara Falls, N. Y.—The Buffalo and Niagara Falls Electric Light and Power Company will have a formal dedication of the new power station in a few days. the programme including a banquet and speech-making. The station is on the lands of the Cataract Construction Company.

New Albany, Ind.—Judge George B. Cardwell, of this place, has been asked to correspond with Eastern capitalists regarding a proposed electric railway between New Albany and Wyandotte Cave. It is thought the traffic would be very large if the facilities for reaching the cave were better.

Benton Harbor, Mich.—W. W. Bean, president of the St. Joseph and Benton Harbor Electric Street Railway, has been brought before the court for shooting at an alderman. The alderman was not killed. Why Mr. Bean did not shoot at a board instead of a lone alderman is a query current among the wags.

Fostoria, Ohio.—The Harrison Telephone Company are organizing a telephone company in this city to be known as the Citizens' Telephone Company. It is to be incorporated with a capital stock of $25,000, $10,000 of which will be taken by local subscribers. It is expected to begin the erection of the plant in a few weeks.

New Orleans.—A few days ago a clutch in the Louisiana Electric Light Company's plant, while spinning around at a dizzy speed flew into pieces doing serious damage to the building and machinery. There was a defect in the iron of the clutch. Owing to the mishap the cars on the Canal street and Judah Hart lines were deprived of motive power for several hours.

Brooklyn, N. Y.—At a meeting of the Brooklyn Electrical Society, held on Thursday night last at the home of the secretary, Arthur A. Fisk, a paper entitled "The Evolution of Electric Traction" was read. The paper was submitted by W. C. Burling, and read by William C. Otten. Previous to the reading of the paper twenty-eight propositions for membership were received.

Scranton, Pa.—The Scranton Electric Construction Company, recently organized here for manufacturing, furnishing, erecting and installing electric or steam plants for various purposes and for furnishing all kinds of electrical machinery and appliances, is composed of Edward B. Sturges, Frederick J. Platt, Orlando S. Johnson, William T. Smith, Frank E. Platt, and Joseph C. Platt.

Detroit, Mich.—Owing to the consummation of the street-car deal, most of the old stockholders in the Detroit Citizens' Street Railway Company have sold out, and a new board of directors is in charge. Thomas Nevins, of Orange, N. J., who managed the deal, has turned over his interest to R. I. Wilson & Co., bankers, of New York. Nevins is said to have made $200,000 by the transaction.

West Chester, Pa.—S. M. Patterson, of the Pennsylvania Traction Campany, has been consulting with a party of New York capitalists in regard to the building of an electric railway from this city to Oxford by way of Unionville, Kennett Square and other points. The route is believed to insure a profitable investment, and the road will be built, says Mr. Patterson, if the property-owners will assist in securing the right of way.

Montreal, Can.—The Canadian Electrical Association opens its three-day convention in the Mechanics' Institute Building on the 19th inst. Several papers on interesting electrical subjects will be read. On the 21st, after the election of officers has taken place, by courtesy of the Eugene F. Phillips Electrical Works, the visitors will drive to Mount Royal park, including a visit to the Montreal Street Railway power house.

Poughkeepsie, N. Y.—The Poughkeepsie lectric Light and Power Company, under consent of holders representing a majority of the capital stock, has made a mortgage of $75,000, covering the property and franchises of the company and to secure a bond issue to that amount. The object is to extend the operations and facilities of the company by adding to its plant the most modern and efficient electrical machinery and appliances. The company's capital stock of $110,000 is all paid in.

Pittsburg, Pa.—The electric fountain in Schenley Park is nearly completed. A practical test made a few days ago indicated that the electrical effects would prove to be all that were expected.—The contract for the building of the Pittsburg, Crafton and Mansfield electric railway has been let. The road is to be in operation by January 1, and will be double tracked clear through. It will be a strong competitor of the Panhandle road for the passenger traffic of the entire Chartiers Valley.

Philadelphia.—The trolley excursion parties that became such a "craze" in this city are no longer in vogue. The Traction Company has ceased to charter its cars for that purpose, and the police are relieved of the task of arresting the disorderly "parties" who made night hideous by their shouting, horn-blowing and other peace-disturbing demonstrations.—The use of electric power for moving turrets on turreted war-ships has been decided on by the Chief of Ordnance after a test of the electrical system on board the old Montauk.

Pottstown, Pa.—The town council of Royersford has granted street franchises to the Pottstown and Norristown Passenger Railroad Companies. The trolley tracks of the former company which now run to Sanatoga Park will be extended to Royersford, where they will connect with those of the Norristown Company, which will extend its line by the route to Collegeville and Trappe. With these roads completed there will be a continuous line of trolley from Pottstown to Philadelphia, via Conshohocken, Spring Mill, Barren Hill and Roxborough.

Lynn, Mass.—The General Electric Company has within a few days shipped from its works here several car loads of electrical apparatus, consigned to the Portland (Ore.) General Electric Company, which is to be set up at Willamette Falls for power transmission. The company has utilized the cars conveying the machinery for advertising purposes, labelling them with its name and that of the Portland company in large letters; this, with the space allotted to an account of the transaction in Lynn and other papers, indicates a design to give this shipment a kind of hippodrome publicity.

Harrisburg, Pa.—A director of the Pennsylvania Traction Company states that a written proposition has been received from a syndicate of Boston bankers, agreeing to build the proposed electric railway line between this city and Philadelphia, a distance of 103 miles, the cars to run at the rate of ninety miles an hour. The syndicate provides that the traction company shall give bonds to secure the cost of the work, which shall not be accepted until it gives entire satisfaction. The proposition includes the construction of the line, power houses and entire equipment. The estimate of the cost is $8,000,000.

Wilmington, Del.—The Chicago Electric Wire Company, of Wilmington, has about completed a sub-marine cable for the United States Government. About $50,000 worth of the cable will be shipped at once to Willett's Point, N. Y. The cable, over 700 miles of which has been made, is to be used by the Government in the torpedo service. The cable is made in seven strands, the core first being covered with jute, then run through a compound of tar and pitch and then has seven strands of metallic wire, covered with tape, twisted around it. It then passes through another tar bath and is then covered with closely twisted Russian hemp.

New York.—The steamer Mackay-Bennett finished the laying of the Atlantic cable in the harbor on Sunday of last week. The shore end of the cable to reach the New York office was herotofore brought from a point near the Oriental Hotel on Coney Island through a conduit overland to Brooklyn and thence across the bridge to the main station in this city, but it was found—at least that was given as the reason—that escaping currents from the trolley lines in Brooklyn interfered with the working of the cable, and so it was determined to bring it direct to the city from the ocean by laying it under water all the way up the harbor after making a splice off Coney Island. The shore line was landed at Pier A, and there connected with a line laid in a subway from the traffic office in Wall Street.

What Will the New York Central Do Next?

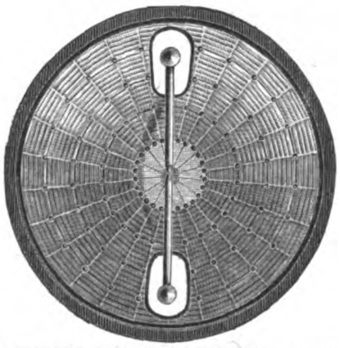
After having his thirst whetted, like a tiger by the taste of blood, by the wonderful performances of Engine No. 999 the *genie* who presides over the transportation department of the New York Central Railroad is rampant again, and laboring persistently to find means of attaining the speed of lightning. He is at work in his cell, by stealth and at midnight, and before many moons have passed we expect to see a terrible apparition coming up the Hudson River like the war chariot of Jove.

We may expect a monster engine, with double boilers of enormous power and wheels as tall as a shot tower—which will trot up to Albany in an hour, skip over to Utica or Syracuse at half hour schedules and cover the distance from New York to Buffalo in three hours. Then we shall need some means of artificial respiration.

The Frink Searchlight Reflectors.

As the subject of electric illumination for night race-tracks is at present being discussed by electricians, we are glad to present to our readers an illustration of the Frink Corrugated Glass Searchlight Reflector, made by I. P. Frink, 551 Pearl street, New York.

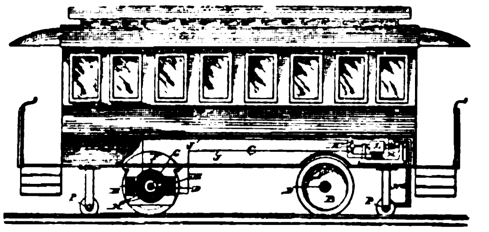
These reflecting searchlights are used in successfully lighting the grounds at the Wild West Encampment, Ambrose Park, Brooklyn, N. Y. They were furnished under the direction of Mr. M. B. Bailey, chief electrician on the grounds, and were installed by the Edison Illuminating Company of Brooklyn.



Badt's Electric Railway System.

A patent has just been issued to Mr. Francis B. Badt, of Chicago, for an Electric Railway system that embodies some features which merit the attention of street railway managers and others interested in improved methods of propelling cars. The *Official Gazette* of the Patent Office furnishes the following details, accompanied by an illustration, reproduced herewith, which gives some idea of the modus operandi of the device:

The combination of a movable vehicle with a motor transformer thereon adapted to be operated by an external multiphase supply circuit, conductors leading from this supply circuit to such movable vehicle, one or more direct current motors on such vehicle attached or geared to the vehicle axle or axles, and connections from the motor transformer to such direct current motor or motors, and devices to make or break the circuit to the direct current motor and to regulate the speed of such motor, said devices located in the circuit connecting the transformer to the direct current motor or motors.



The Harrisburg Engines.

The Harrisburg Foundry and Machine Works have recently issued a new catalogue describing a number of patterns of the Harrisburg double engine road roller. This company being the pioneer manufacturers of road rollers in this country have brought to bear on their present machines the results of fourteen years of practical experience in their manufacture.

They also manufacture boilers and engines, including the well-known Ide and Ideal automatic cut-off engines, of which we have received a portfolio of handsome illustrations.

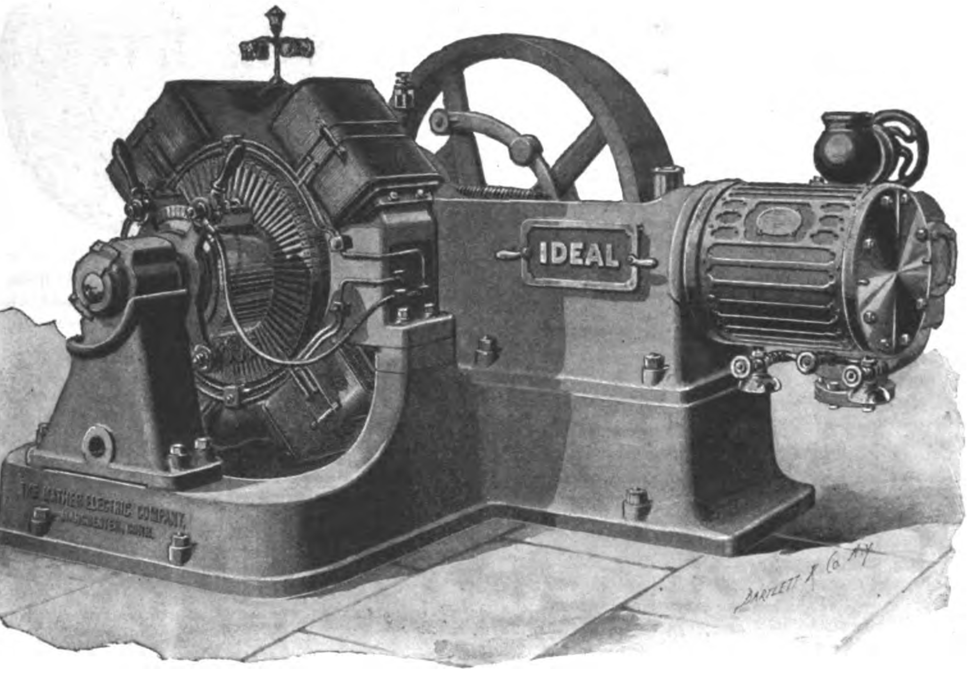
Improved Mather Multipolar Dynamos.

We give below a photo-engraving of the Improved Mather Multipolar 100 K. W. Direct-Connected Dynamo and 150 H. P. Ideal Engine. The productions of the Mather Works are so well and favorably known that it is only necessary to call attention to some of the latest forms of machinery which this enterprising company are turning out at their Manchester, Conn., manufactory to satisfy the reader that another step has been taken toward the perfection in construction and utility which this company is evidently ambitious to attain. The advantages of the direct-connected apparatus are: First, economy in floor space, this advantage being especially appreciated where the Generator is in crowded or limited quarters; second, the annihilation of all noise in the operation of the plant, which is accomplished by the absence of all belting, etc.; third, economy in operation over a belted plant, which is very great at all times, but especially so where the load is of an intermittent nature, or where the plant is not operating at its full capacity at all times; fourth, extreme simplicity and minimum requirement of attention, and long life of apparatus on account of slow speed in operation.

The Direct-Connected Generators manufactured by the Mather Company are the result of years of experience, both in this country and abroad, and embody the most advanced ideas in design and construction in this class of apparatus.

One great advantage of their Direct-Connected Generator is that on account of the field and armature being practically identical with those of their standard Multipolar Generators they have been able to design testing frames upon which before shipping every Generator can be set up and run under conditions similar to those it is intended to meet in actual practice, and no machine is allowed to leave the factory unless meeting all requirements as to its mechanical and electrical perfection.

Four or more sets of brushes, as may be required, according to the conditions, are used on these Generators.



IMPROVED MATHER MULTIPOLAR 100 K. W. DIRECT CONNECTED DYNAMO.

Each brush is held in an independent holder; hence any single brush can be raised from the commutator without disturbing the others, and each, having its own spring, may be perfectly adjusted. The diametrically opposite brushes are of the same polarity and are connected. The rocker arm of the brush holder is of rigid construction, and the different parts are perfectly insulated; it is designed so that it will adjust all the brushes simultaneously.

The Mather Direct-Connected Generators are all standard machines and any part can be duplicated at once, with the least expenditure of time and money.

An Electric Coal-Mining Machine.

The use of electricity in mine-working is rapidly bringing about great changes in that industry, leading to the introduction of labor-saving machinery and more economical methods in detaching and bringing to the surface the mineral deposits so snugly stored in the earth. For this purpose one of the best devices for its work that have come to our notice lately is the "Jeffrey Electric Coal-Mining Machine Junior," manufactured by the Jeffrey Manufacturing Company, Columbus, Ohio. This machine consists of a bed frame occupying a space 2 feet wide by 8 feet 6 inches long, composed of two steel channel bars firmly braced, the top plates on each forming racks with their teeth downward, in which the feed wheels of the sliding frame engage. Mounted upon and engaging with this bed frame is a sliding frame, similarly braced, consisting mainly of two steel bars, upon which are mounted at the rear ends one electric motor, from which power is transmitted through straight gear and worm wheel to the rack, by means of which the sliding frame is fed forward. Upon the front end of this sliding frame is mounted the cutter-bar, held firmly by two solid steel shoes, with suitable brass boxes. The cutter-bar contains bits, made of tool steel, held in place by set screws. When the cutter-bar revolves these cutters or bits cover its entire face. The cutter-bar is revolved by an endless curved link steel chain from the driving shaft, and is advanced by the mechanism into the coal or other material to be under-cut, to the desired depth.

The electric motor occupies a space about 20 inches square. The current required is from 30 to 50 amperes at a pressure of 220 volts; each motor is wound to develop 15 H. P. actual, though frequently only 7½ H. P. is used in making cuts in coal. The machine is started by means of a switch located on the resistance box on rear end of motor, the same being arranged with buttons, and the current is gradually turned on by passing the lever over them. The momentum of the armature is such that ordinary obstructions met by the cutter-bar in the coal are imperceptible, causing the machine to run steadily and with comparative quietude. The machines are operated by two men, one in charge, the other as helper. Trucks are furnished with the machines, so that they can be handled with ease. The machine is taken into the mine upon the truck and run into the room to be under-cut; it is then placed on two boards in front of the coal at one side of the room and fastened firmly by means of the front and rear jacks, which are braced against the face and roof of the coal; this prevents the machine from moving while in operation; the power is then turned on by the machine runner and the machine proceeds to its work. In some coal veins the machines are stated to have cut at the rate of 130 and 150 lineal feet face in ten hours to a depth of six feet.

COMMERCIAL PARAGRAPHS.

The Colburn Electric Mfg. Co., of Fitchburg, Mass., have issued a new catalogue describing their electric generators and motors. These machines have been on the market since 1881, and their type is too well known to need description. In addition to their lighting dynamos they manufacture also machines for electroplating, the smallest size of which is designed to be run by foot power.

The Mather Electric Company of Manchester, Conn., report the shipment last week of two of their 1,000-light ring type Dynamos, with complete switchboard, for the new Davidson Theater at Milwaukee, Wis. This order was secured through Mr. J. Holt Gates, of Chicago, the well-known Western contractor of the Mather Company.

INCORPORATIONS.

The Tampa and Palmetto Beach Railway Company, Tampa, Fla.—to build, equip and operate a street railway in Tampa, and from Tampa to Palmetto Beach; to own and operate electric plants. Capital stock, $30,000. Promoters: R. W. Easley, W.H. Kendrick, Louis T. Kendrick, Tampa.

The Oroville Gas, Electric Light and Power Company, Oroville, Cal.—to deal in and operate electrical and gas works machinery, appliances and franchises, and sell light and power. Capital stock, $32,000. Promoters: Max Marks, Fred H. Gray, C. H. Shiveley, J. C. Osgood, C. W. Putnam, W. J. Schneider, W. E. Duncan, Jr., Oroville.

The Riverside Electric Railway Company, Harrisburg, Pa.—to build and operate a street railway line in Harrisburg. Capital stock, $50,000. President, Wm. K. Alricks; directors: John Q. Denny, H. B. McCormick, Joshua Gross, W. S. Boas, Wm. B. Hammond, all of Harrisburg; E. C. Felton, Steelton; Philip Felty, Fort Hunter; J. Lewis Heck, Hecktown.

The Chateaugay Electric Light and Power Company of Chateaugay, N. Y. Capital stock, $6,000. Directors: Ernest A. Douglass, Herbert G. Douglass, Martha A. F. Douglass, Hattie E. Douglass and Albert S. Douglass, of Chateaugay.

The American Electric Exercising Machine Company, Chicago. Capital stock, $50,000. Incorporators: James W. Williams, H. J. Weld and W. R. Bullon.

The Sanatoga, Royersford and Collegeville Electric Railway Company, Philadelphia, Pa.—to construct, maintain and operate an electric street railway. Capital stock, $150,000. Promoters: Paul W. Smith, Clark Dillenbeck, Philadelphia; Jno. C. Lynch, Royersford, Pa.

The Acme Electric Light and Power Company, North East, Pa.—to manufacture and supply light, heat and power, or any or all of them, by means of electricity. Capital stock, $15,000. Promoters: B. E. Hillman, J. A. Stetson, W. D. Wells, North East.

The Norwood Electric Light and Power Company—to furnish electricity in Norwood and Potsdam, St. Lawrence County, N. Y. Capital stock, $5,000. Directors: George W. Richards, William D. Fuller, Frank L. Smith, and others, of Norwood.

The American Electric News and Money Transfer Company, Bridgeport, Conn.—to transact a general telegraphic business with wires running to any part of the country. Capital stock, $5,000. Incorporators: Thomas J. Brady, Bridgeport; Albert Bangs and Philip Brady, New York.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED SEPTEMBER 4, 1894.

ELECTRIC RAILROADS AND APPLIANCES.

525,336. Controlling Device for Electric-Railway Cars. William H. Conrad, Lebanon, Pa., assignor of two-thirds to Jacob M. Shenk and William P. Coldren, same place. Filed Jan. 8, 1894.

525,480. Electric-Railway System. Francis B. Badt, Chicago, Ill. Filed Oct. 22, 1892.

525.523. Electromagnetic Tractile Device. Charles M. Allen, San Francisco, Cal., assignor of one half to Robert T. Murray, same place. Filed Aug. 22, 1893.

525,539. Conduit Electric-Railway System. Oscar A. Enholm, New York, N. Y., assignor to W. Dean Smith, same place. Filed April 17, 1894.

525.598. Overhead Switch for Trolley-Wires. Hugh M. Greenwood, Brooklyn, N. Y. Filed Dec. 1, 1893.

ELECTRIC LIGHTS AND APPLIANCES.

525,369. Electric-Lighting System and Apparatus. Elihu Thomson, Lynn, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Feb. 21, 1887.

525,564. Handpiece for Portable Electric Lamps, August Rockoff, New York, N. Y. Filed May 10, 1894.

525,571. Headlight Reflector. Mark O. Ainslie, Cincinnati, Ohio. Filed Dec. 18, 1891.

525,653. Rosette for Electric-Light Wires. Charles N. Hammond, Boston, Mass. Filed Jan. 15, 1894.

MOTORS, DYNAMOS, ETC.

525,353. Dynamo-Electric Machine. James F. McElroy, Albany, N. Y., assignor to the Consolidated Car Heating Company, Wheeling, W. Va. Filed Jan. 10, 1891.

525,394. Controller for Electric or Other Motors. Elmer A. Sperry, Cleveland, Ohio, assignor to the Sperry Electric Railway Company of Ohio. Filed July 21, 1894.

525,445. System of Electrical Distribution. Thomas C. Coykendall, Rondout, N. Y. Filed Jan. 4, 1894.

525.446. System of Electrical Distribution. Thomas C. Coykendall, Rondout, N. Y. Filed Jan. 18, 1894.

525.447. Alternating-Current Motor. Olof Dahl, Paterson, N. J. Filed Dec. 8, 1892.

TELEPHONE AND TELEGRAPH APPARATUS.

525,623. Automatic Toll-Box for Telephone Pay-Stations. Howard C. Root, Brooklyn, N. Y. Filed March 22, 1894.

525,649. District-Telegraph Call. William H. Garven, Portland, Oreg. Filed Feb. 19, 1894.

BATTERIES.

525,491. Electric Battery. Luis Drescher, New York, N.Y. Filed March 23, 1894.

MISCELLANEOUS.

525,332. Electric Switch. George F. Card, Covington, Ky., assignor to the Card Electric Company, Mansfield, Ohio. Filed April 14, 1894.

525,354. Electrical-Current Director. James F. McElroy, Albany, N. Y., assignor to the Consolidated Car Heating Company, Wheeling, W. Va. Filed July 1, 1891.

525,400. Electric Lock. Frederick Apitz, Lockport, Ill. Filed May 31, 1894.

525,437. Electric Cigar Lighter. Albert C. Albertsen, Chicago, Ill., assignor to Charles E. Patrick, same place. Filed Nov. 29, 1893.

525,505. Electromagnetic Car-Brake. Robert T. Murray and Charles M. Allen, San Francisco, Cal. Filed Oct. 24, 1892.

525,555. Apparatus for Electrolytical Decomposition. Alf Sinding-Larsen, Christiania, Norway. Filed Aug. 31, 1893.

525,563. Electrical Cut-Out. August Rockoff, New York, N. Y. Filed May 10, 1894.

525,670. Underground Conduit. Alexander Segade and Dennis J. O. Regan, Detroit, Mich., assignors of one-half to Patrick McCoy, same place. Filed March 6, 1894.

ELECTRICITY.

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EDITORIAL NOTES.

The Feeder and Main Patent. The decision of Judge Acheson in the case of the infringement suit brought by the Edison Electric Light Company against Westinghouse, Church, Kerr & Company practically invalidates the feeder and main patent and deprives the General Electric Company of its absurd claim to the absolute control of low tension distribution of electricity. From the slightly condensed text of Judge Acheson's decision, which is printed elsewhere, it will be seen that the rejection of the patent is based entirely upon the ground of lack of invention, which was found so decisive that none of the other arguments offered were considered.

The comparatively slight knowledge of electric lighting by multiple-arc distribution that existed at the date of this patent led to the admission of a great many very broad and even vague claims in this field, and the vast number of patents taken out for the most trivial devices—many of which are useful only as estimated assets in patents—have proved great drawbacks to the electrical trade besides costing enormous sums for litigation. In the present case the taking of testimony and the legal proceedings have occupied about seven years, and both the Westinghouse Company and their attorneys, Messrs. Kerr and Curtis, are to be congratulated upon their final success.

We pointed out in ELECTRICITY at the time the favorable decision of the Circuit Court of New Jersey was announced, that the broad sustainment of this patent would cover practically all central stations and isolated plants for low tension currents, as well as most electric railway systems, for the reason that it is almost impossible to lay out any ramified system of wiring which the claims of this patent will not cover. The use of feeders and consumption circuits was well known long prior to Edison's patent, as this scheme is described and illustrated in Khotinsky's patent of 1875, and had been in common use in equalizing the potential among articles in electroplating baths. As the patent reads, however, it was practically impossible to connect a consumption circuit to the dynamo without infringing it, as the specification states in regard to the feeder loss that "it may be, for example, about 15 per cent., but circumstances might make it desirable to diminish the loss upon the feeding conductors down even as low as that upon the main conductors of the consumption circuit or circuits, or to increase the loss upon the feeders to more than 15 per cent." The only possible method not covered by this patent is, therefore, to give the feeder less drop than the mains, which is obviously merely a waste of copper.

It is to be noted that in Judge Acheson's decision, which is brief and decisive, every point of the argument resolves itself against the validity of the patent, and his conclusions are drawn from facts which every electrician must admit. Stripping the subject of all verbiage, he states that the gist of the alleged invention is merely the combination and proportioning of the two parts of the circuit, and makes the significant remark that "the claims here, we think, were purposely framed broadly, so as to cover the simplest form of the alleged invention." It is certain that an electrical engineer of ordinary intelligence would, at the very outset of incandescent lighting, proportion the size of his mains with reference to the resistance of the wire used, or as the Court puts it, "he would have made the main conductors of the consumption circuit sufficiently large to be of practical utility."

Having thus recognized the practical impossibility of evading this invention in the course of practical work the following pertinent query, which appears to cover the whole case, is propounded: "How can it be affirmed that it would require invention simply to proportion Khotinsky's circuit in the manner contemplated by the patent in suit—to make his transmitting wires and distributing conductors, respectively, of suitable size to perform their intended functions?"

After a lucid argument showing the lack of invention involved in the patent, the Court strikes the keynote of the present litigation: "To sustain these claims would be to sanction a monopoly in that which belongs to the public."

The present decision is the most decisive blow that the General Electric Company has received as yet, and effectually denies its vaunted claim to monopoly of low tension current distribution. The feeder and main patent was undoubtedly the most powerful weapon in the hands of the Trust, both as a threat to competitors and a warning to customers. Without this weapon their monopolistic claims merit still further the contempt into which they have long since fallen.

The friends of the Trust, and particularly their counsel, affect, according to the daily paper reports, to treat this decision as a matter of slight importance. In a reported interview their attorneys expressed the opinion "that the decision will not deprive General Electric of any business which it has heretofore enjoyed. They say that despite the decision of the lower court, rendered some time ago, competitors of General Electric have been using the 'feeder and main' system on their apparatus. The system's greatest utility is in connection with the low tension circuit, which General Electric controls through other patents."

The fallacy of such statements, however, is apparent, as no sane business men would be guilty of spending years of litigation and a hundred thousand dollars or more in defence of a patent which would be of no financial benefit to them.

* * *

Sine Curve E. M. F. The controversy which has been in progress in regard to the relative value of sinusoidal and non-sinusoidal curves of E. M. F. for alternating current work has been vigorously prosecuted by our contemporary, the London *Electrician*, which denounces the attempts to produce the sine curve E. M. F. in alternators as a waste of time. After a somewhat lengthy argument in defence of its views, the *Electrician* concludes: "Confidently as we maintain that a sine curve is not the best, and that a flat topped curve is better, we must point out that the difference when reduced to £ s. d. is but a trifling amount. The experiments to which we have alluded agree well with those of Mr. Steinmetz, viz., that the iron losses in generator and transformer were about 10 per cent. greater with a sine curve than with a flat-topped curve."

As far as the generator and transformer are concerned, the choice between the sine curve and the flat topped curve is not of any great value where electric lighting alone is considered. Mr. Steinmetz has pointed out that the hysteretic loss is greater with the sine curve than it is when the third harmonic is in anti-phase with the fundamental wave, but beyond the loss by hysteresis he offers no proof in favor of the flat-topped curve.

As far as the question of transformer efficiency and lighting plants are concerned no very great advantage has been claimed for the sine curve by any of the American engineers quoted by the *Electrician*. In fact, Messrs. Houston and Kennelly state that "the extra loss of energy through non-sinusoidal E. M. F. waves is usually not of sufficient importance to render a strictly sinusoidal E. M. F. of great value for merely lighting purposes," and Dr. Duncan supplements this by the statement that "it is undoubtedly a 'complete waste of time and energy' to make elaborate attempts to produce sine curve alternators for lighting."

The only important contention in favor of sine curve has been in regard to its relation to power transmission with rotary field motors, and on this point our contemporary touches but lightly and apparently considers it of minor importance. The theory and mathematical proof of the advantages of the sine curve have been published too frequently to need repetition here, but our contemporary questions both theory and mathematics, and calls for facts, although its own arguments are not supported by the result of even a single experiment in motor work.

In reality mathematics has had but very little to do with the production of alternators giving a sine curve of E. M. F., as no great importance was attached to this feature until alternate current motor work gave it prominence. It was thus practical considerations alone, and not mathematics, that called for a sinusoidal E. M. F.

A number of specific cases of the advantages of the sine curve have been instanced during this discussion, which are solely based on the experiments of the writers. The researches of Dr. Duncan and Dr. Pupin, which are also experimental, have all led to the same conclusion as to the value of a pure sine curve, but as our contemporary is still unconvinced by the evidence presented by Americans, it will probably gain some valuable experience when this line of motor work is undertaken in England.

* * *

Mr. Coffin's Early Views. Soon after Mr. Coffin came to New York, in the early months of the consolidation, in conversation with an old-time New England friend, he talked with great frankness of his individual plans.

Passing lightly over the prospects of success for the company itself, he dwelt at great length on the possibilities for making money rapidly which a man in his position could avail himself of. He said: "Wall Street is a wonderful place to make money rapidly for any man of level head and good judgment; but for a man in my position who has the benefit of inside information, the chances are simply marvellous. I expect to make more money here in five years than a man could ordinarily hope to make in two lifetimes. Wall Street people have the reputation of being very shrewd, but their knowledge of the situation is only superficial; and in the handling of electrical securities we can give them points."

This shows, we think, very clearly, the frame of mind in which Mr. Coffin undertook the management of one of the largest corporations in America, one in which the small savings of widows and minor tradesmen, trust funds, and funds of savings institutions had been invested, and which he was daily recommending his bosom friends to put more money into. His "superior knowledge of the situation" has cost these investors something like $25,000,000 so far, and the end is not yet.

Is it any wonder that his old-time friends and neighbors scorn him, and that he rarely goes to his home at Lynn in daylight? If he had paid more attention to the conduct of the company's business, and less to gambling in Wall Street, his friends would not have deserted him and he would have been entitled to some measure of respect, even though the gigantic scheme was a failure.

Smarter men than Mr. Coffin have attempted to beat the Wall Street game and failed, yet he will have many successors. But the bank has never been broken, and the game is unbeaten. Old operators smiled when Mr. Coffin came into the Street, not at all awed by his superior knowledge of the situation. They ran the game when he first appeared, and they are still in business at the old stand.

* * *

Some weeks ago Mr. Coffin personally gave out an item to the daily papers stating that a consignment of twenty five carloads of electrical apparatus had been shipped from the Lynn works to the Northwest. This, it was said, was the largest shipment ever made in the history of the business and showed the healthy condition of the company. Electricity has been at some pains to find out the particulars in regard to this wonderful shipment, and we can state facts. The apparatus was the final shipment on an order taken some two years ago, which appeared on the company's books as actual business, for the purposes of the first report, covering eight months' work. More than this, it was not a cash transaction, bonds having been taken at that time for the entire trade; and so far as this year's business is concerned the twenty five carloads of apparatus will appear on the wrong side of the balance sheet. If Mr. Coffin were either as honest or as smart as he was ten years ago, he would not be so easily caught in attempts to defraud the public by means of statements absolutely false.

* * *

It has been stated recently in Boston, and by a man who ought to know, that an examination of the stock book of the G. E. Company would show that the entire recorded holdings of the Board of Directors of the company do not aggregate $10,000 of the common stock. Is it not time for some of the gentlemen who made large investments in this stock, on the direct recommendation of members of the Board, to have this matter investigated and give to the world the extent of the swindle which has been carried on?

* * *

The defeat of the G. E. Company on their boasted feeder patent is a staggerer. The knock-out blow will come from the U. S. Supreme Court next November.

* * *

I've lost my grip, I've lost my friends, I've nearly lost my pile; but, worse than all, fore'er I've lost my million-dollar smile—says Charlie.

* * *

Blackmailing patent suits will not be so numerous hereafter.

* * *

We ask it again, What have the Licensees to gain?

Edison Feeder Patent Void

The U. S. Circuit Court of Appeals Reverses the Decision of the Circuit Court.

An opinion was filed by Judge Acheson in favor of Westinghouse, Church, Kerr & Co., on September 11, in the infringement suit brought by the Edison Electric Light Company. The case was appealed by the defendants last March from a decision of the Circuit Court of New Jersey under which they were enjoined from infringing the Edison patent, No. 264,642, commonly known as the Feeder and Main Patent.

The three claims of the patent which were held to be infringed are as follows :

"1. A consumption circuit, in the main conductors of which the drop in tension is not sufficient to vary practically the candle-power of the lamps connected therewith, in combination with feeding conductors connecting the consumption circuit with the source of electrical energy, and having no translating devices connected therewith, the drop in tension upon such feeding conductors not affecting the relative candle-power of the lamps of the consumption circuit, substantially as set forth.

"2. A consumption circuit in the main conductors of which there is a definite small drop in tension, not sufficient to vary practically the candle power of the lamps connected therewith, in combination with feeding conductors connecting the consumption circuit with the source of electrical energy, and having no translating devices connected therewith, the loss upon such feeding conductors being greater than upon the main conductors of the consumption circuit, substantially as set forth.

"3. The combination of a consumption circuit, in the main conductors of which the drop in tension is not sufficient to vary practically the candle power of the lamps connected therewith, with a feeding circuit having no translating devices, and extending from the source of electrical energy to the center of the consumption circuit, substantially as set forth."

The decision of Judge Acheson states in part :

"For the proper determination of this case it is essential that the subject matter of these claims should be clearly understood. This patent does not deal with the complicated general problem of the distribution of electricity and the subdivision of the current for the purpose of domestic illumination. The patent is not for an incandescent lamp, or for a dynamo for generating electricity, or for the arrangement of the lamps in multiple-arc, or for indicating and regulating devices for controlling the current from a central station, singly or combined. The patent deals with the one particular difficulty of drop in tension or fall of pressure—loss of electromotive force—due to the resistance of the conductors to the electric flow. To remedy the evil effect therefrom the patentee provides special conductors for the transmission of electricity, extending from the generator to the main conductors with which the lamps are connected and from which they are served. The patent is for a specific arrangement and proportioning of the two sets of conductors which together constitute the complete circuit.

"The claims in question are perfectly clear and definite. Each claim is for a combination consisting of two constituents, namely, a consumption circuit in the main conductors, of which the drop in tension is not sufficient to vary practically the candle power of the lamps connected therewith, and feeding conductors (a feeding circuit) having no translating devices thereon, uniting the consumption circuit with the source of electrical energy. Plainly, each of these claims is for a single circuit composed of a pair of transmitting conductors having the specified characteristics without regard to any other like circuit. The gist of the alleged invention is in the combination and proportioning of the two parts of the circuit, and not in the scale of use.

"Contrary to these views, the Circuit Court was of the opinion that certain unexpressed qualifications are to be incorporated into each of the claims by virtue of the concluding words 'substantially as set forth.' Accordingly, the Court construed these several claims as involving the lighting of a 'large territory' by the use of 'large numbers' of incandescent lamps, and as implying central station regulation whereby variable drop in tension in remote parts of the system may be controlled. But, in our judgment, these limitations are inadmissible. The fact is, pending the application for this patent, it was sought to amend the specification and insert a new claim by the introduction of the matter of central station regulation, but the Patent Office rejected the proposed amendment for the assigned reason that 'it describes and claims an invention not even hinted at in the original specification nor shown in any of the drawings.'

"While central station regulation is incidentally referred to in the introductory part of the specification, it is not described at all, and clearly is no part of this alleged invention.

"The claims in question are unambiguous and exact. Upon well settled principles, then, limitations other than those expressed are to be excluded (Railroad Company vs. Mellen, 104 U. S., 112; Yale Lock Company vs. Greenleaf, 117 U. S., 554; White vs. Dunbar, 119 U. S., 47, 52). As was stated in the last cited case, 'the claim is a statutory requirement, prescribed for the very purpose of making the patentee define precisely what his invention is; and it is unjust to the public, as well as an evasion of the law, to construe it in a manner different from the plain import of its terms.' The claims here, we think, were purposely framed broadly, so as to cover the simplest form of the alleged invention.

"The primary question for solution, then, is, whether it involved invention in a patentable sense to combine a circuit for feeding only with a consumption circuit the main conductors of which are so proportioned as to maintain such uniformity of pressure upon them that there is practically no variance in the candle power of the lamps connected therewith.

"Now a claim for a combination carries with it an implication that the separate elements are old. In the present instance the positive proofs accord with the implication. Most certainly the patent in suit discloses no new means either for transmitting a current of electricity or for equalizing pressure upon the consumption circuit.

"It is to be noted that the patent leaves it altogether to the judgment of the electrical engineer, or contractor, to determine the relative lengths of the two parts of the combined circuit and the proper thickness of the conductors. As to these points no definite instructions are given. Undoubtedly it was well known prior to the alleged invention that a large quantity of electrical energy could be transmitted a considerable distance by a conductor of small size. Now, with respect to the loss of pressure upon the feeding conductors—which loss depends upon the thickness of the conductors—the specification tells us that 'this loss will be varied according to localities and the relative cost of copper for conducting purposes and horse-power for generation.' It is said that in large and extended systems this loss would generally be greater than the loss upon the main conductors of the consumption circuit, and 'may be, for example, about fifteen per cent., but that circumstances might make it desirable to diminish the loss down even as low as that upon the main conductors of the consumption circuit, or to increase the loss upon the feeders to more than fifteen per cent.' Thus is it left where, indeed, it properly belongs—to the intelligence of the electrical engineer—to select feeding conductors of larger or smaller diameter, depending upon the comparative cost of copper and of power, or upon some special circumstances.

"Of a truth, the feeding conductors of the patent are nothing more than the ordinary supply wires running from the source of the electrical energy. The proper function of such conductors being to transmit the electric current to the point where it is to be utilized, as a matter of course they have no 'translating devices connected therewith.' The statement in the specification—'It will be seen that the drop upon the feeding conductors has no effect upon the relative candle power of the lamps, being affected only by the drop upon the main conductors of the consumption circuit or circuits between the end of a set of feeding conductors and points most distant from any feeding conductors'—is the mention of an obvious fact. Indeed, it is put as a self-evident proposition. That no loss upon the supply part of the circuit can affect the relative candle-power of the lamps upon the consumption part of the circuit is a quality inhering in the circuit by the very nature of things. It is a necessary incident of any circuit part of which supplies the current and part of which distributes it.

"The specification states that 'in order to maintain practically the same candle-power throughout the system, the main conductors of the consumption circuit or circuits should be so proportioned that the drop in tension upon them shall not exceed a definite small limit—for example, five per cent.'—but gives no information whatever how that is done. This silence is highly significant. The specification assumes that to secure uniformity of electrical pressure, and thus uniformity of effect, is a matter of common knowledge among those skilled in the electrical art, as indeed it was.

"Turning now to the Khotinsky French patent of 1875, which relates to the art of electric lighting, we discover that it shows and describes a circuit of feeding and consumption parts in combination, identical in form with that of the patent in suit. The lamps of Khotinsky's system are incandescent lamps, and they are arranged in multiple arc. He shows a magneto-electric machine located 'in the center of this system or at any other point.' From the magneto-electric machine run two 'conducting wires' with which no translating devices are connected. These conducting or feeding wires connect with the 'main conductors' of the circuit with which all the lamps are connected. Undeniably, Khotinsky's combined arrangement of feeding conductors and distributing conductors is precisely the arrangement of the patent in suit. Nothing indeed is said by Khotinsky about proportioning the main conductors of the consumption circuit so as to prevent injurious drop in tension. It was, however, wholly unnecessary for him to say anything upon that subject. All that was needful to overcome the difficulty due to drop in tension was to make the main conductors of the consumption circuit of proper thickness. The laws governing the flow and distribution of electricity in conductors were perfectly well known to electricians at the date of Khotinsky's patent, and any electrical engineer of ordinary skill then called on to construct a circuit of Khotinsky's system, it is to be assumed, would have acted in accordance with common electrical knowledge, principles and practice ; in other words, he would have made the main conductors of the consumption circuit sufficiently large to be of practical utility.

"How can it be affirmed that it would require invention simply to proportion Khotinsky's circuit in the manner contemplated by the patent in suit—to make his transmitting wires and distributing conductors, respectively, of suitable size to perform their intended functions?

"Now, it is quite true that prior to the year 1880 electric lighting for ordinary domestic purposes was not an accomplished fact. But this was not for lack of anything shown by the patent in suit. The great desideratum was a practical incandescent lamp.

"Under the proofs, we cannot assent to the suggestion that the alleged invention here in question supplied a long felt want, or met a difficulty generally recognized in the art as a serious hindrance to the distribution of the electric current. In fact, prior to the application for this patent no incandescent electric lighting plant had been built. There had been no occasion to erect such plants, for no practically successful incandescent lamp had yet been furnished to the public. Hence, electrical engineers had not been called upon to deal practically with the problem of drop in tension in the construction of such plants. In truth, the feeder and main system of distribution came naturally, in the ordinary progress of the art of incandescent electric lighting, as and when needed.

"The multiple arc or derived circuit system of distribution being confessedly old, and the high resistance incandescent lamp having been devised to provide 'feeding conductors which extend from the generator or generators to the main conductors of the lamp of consumption current,' was, it seems to us, an obvious engineering expedient. Then, as already shown, the proper proportioning of the two parts of the combined circuit involved only the exercise of the common knowledge and skill of the electrician. The plan of electric distribution covered by the claims in question is not 'the creative work of that inventive faculty which it was the purpose of the Constitution and patent laws to encourage and reward.' To sustain these claims would be to sanction a monopoly in that which belongs to the public.

"The decree of the Court below is reversed, and the cause is remanded, with directions to enter a decree dismissing the bill of complaint, with costs."

American Institute of Electrical Engineers.

The 89th meeting of the American Institute of Electrical Engineers will be held at headquarters, 12 West 31st street, New York City, on Wednesday, September 19, at 8 P. M.

A paper will be presented by Frederick Bedell, Ph. D., and Carl Kinsley, A. B., M. E., of Ithaca, N. Y., on "A Study of the Residual Charges of Condensers and Their Dependence Upon Temperature." As arranged with the authors, this paper will be read by title, but will be open for discussion. A paper will also be presented by Mr. Elmer A. Sperry, of Cleveland, O., on "The Electric Brake in Practice." This paper will be accompanied by practical demonstrations.

A meeting of Western members for the reading and discussion of the above papers will be held on the same evening, September 19th, at the Armour Institute, 33d street and Armour avenue, Chicago, Ill.

Members of the American Society of Civil Engineers, American Society of Mechanical Engineers, and Western Society of Engineers are especially invited to attend.

The August issue of the Transactions, containing the above papers, will be distributed previous to the meeting.

An electric rock rests on the summit of Alpine Peak, California. It is so full of electricity that it is perilous to touch it.

Thomson-Houston Patents in England.

The Railway World, London, states that the Laing, Wharton and Down Construction Syndicate, Limited, Parliament street, Westminster, having acquired the Thomson-Houston patents and interests in the United Kingdom, have now vested them in the British Thomson-Houston, Limited, which has recently been formed for the purpose of engaging in the construction of electric tramways. The new company is in direct affiliation with the parent Thomson-Houston Company of America. Their first undertaking in this country will be the electrical equipment of the Dublin Southern lines of the Imperial Tramways Company, the contract for which has already been arranged. Several officers of the new company, who have had great experience in electric traction work, and have recently inspected the Dublin lines, have formed a high opinion of the capacity of the lines when worked by electricity. The immediate expenditure for laying the double line, the construction of a power station, and equipping the line with electric power and motor cars, is estimated at about £70,000. Towards this outlay the Imperial Company propose to raise by debentures £10,000, and the remainder will be mainly subscribed by the British Thomson-Houston, Limited, while the permanent way contractor, who shares their views as to the future success of the line, will take up the balance. The Thomson-Houston Company's experts and the directors of the tramway company calculate that by the employment of electric traction traffic will be very materially increased, as it will enable them to substitute a five minutes' service for the fifteen minutes' service which is now given, while the percentage of expenditure on the increased traffic will be reduced to 55 per cent. This will enable ample profit to be made with which to pay the preferential charges on the new capital, and leave a substantial dividend on the ordinary capital, all of which is owned by the Imperial Tramways Company.

The Electric Furnace in the Production of New Substances.

By experiments recently made it has been discovered that many new substances, some of commercial value, can be formed through the agency of the electric furnace. M. Moissan, who has been indefatigable in his efforts to bring this type of furnace into practical use, has been demonstrating its value as a means of producing substances which have hitherto baffled all ordinary chemical processes. Amongst these we may notice calcium carbide, barium and strontium carbides, and carbon boride. The first of these is produced by placing an intimate mixture of lime and carbon in the crucible of the electric furnace, and subjecting it to the action of a current of 350 amperes and 70 volts for 15 or 20 minutes. The same current serves for the production of barium or strontium carbide, the mixture used being baryta or strontia with carbon. Carbon boride is formed when the electric arc is allowed to pass between two carbons agglomerated by means of a solution of boric acid and aluminium silicate; or when boron is placed in the arc, or by the action of the current upon a mixture of amorphous boron and carbon. The last named process requires a current of 250–300 amperes and 70 volts applied for six or seven minutes. The success of these operations appears largely to depend upon the employment of carbon that has been obtained from the ignition of sugar. There is no doubt that at least one of these substances will find immediate commercial application, for carbon boride, though very friable, is also very hard, and in spite of its being slightly softer than diamond, it can be used very successfully for polishing and cutting these stones.

The Future Incandescent Lamp.

In describing the article by G. Claude in *L'Industrie Electrique* the London *Electrical Engineer* states that the writer points out theoretically that for a given temperature the quantity and quality of luminous radiations emitted by a body of determined dimensions depend essentially upon the nature of this body. One has to take as a luminous source a body of which the coefficient of emission is as high as possible. On the other hand, in proportion as we rise in the temperature scale, the proportion of the luminous radiation to the total radiation rapidly increases, as shown by M. Larnaude. Thus from two identical sources, of which one is at a temperature only a little higher than the other, the luminous efficiency of the latter is much superior. It is then necessary to raise the emissive body to as high a temperature as possible. Passing from this standpoint, the writer suggests that it is possible in future that we may be able to utilize for filaments bodies that are not now usable, and which will withstand higher temperatures, as shown by the experiments of M. Moissan. From an industrial point of view, M. Claude asks the reason why central stations use potentials of at most 120 volts, or 24) volts when recourse is had to the three-wire system? Why employ such low voltages, when the immediate result of this fact is to require a system of mains of enormous section and of considerable expense? The writer answers his own questions by stating that the reason lies simply in the fact that the existing incandescent lamp does not allow of our working otherwise, because the carbon being relatively very conductive the filaments that can be obtained for lamps of low luminous intensity would be unable to bear differences of potential exceeding from 100 to 120 volts, unless they are too fragile. Thus there have been made lamps of 16 C. P., and even 10 C. P., with a single filament working at the extreme limit of 200 volts, but these lamps are not practical. It is true that we could without inconvenience in the majority of cases branch the lamps two in series, but this method is generally repudiated. It might be difficult to believe that such a slight cause could bring about this result, but nevertheless that is the exact truth. The actual conditions of manufacturing incandescent lamps are the sole reason of the limitation of lighting distribution. But, M. Claude continues, suppose, on the other hand, that among the new compounds brought to light by M. Moissan there are some, or even only one, which has combined with extreme refractory properties a conductivity two or three times less than that of carbon. Suppose from now it is allowable to obtain practical solid filaments working under 300 or 400 volts, so also from now would the electric lighting industry be revolutionized. The efficiency of the incandescent lamp being raised to much more satisfactory values, central stations would cease to be trammelled by the necessity of laying mains for such a low pressure as at present used, and only have to concern themselves about voltage from the point of view of public safety. It will be from this direction, M. Claude concludes, that progress will be effected in the manufacture of incandescent electric lamps.

New Phonograph.

A new form of phonograph recently described before the Berlin Electro Chemical Society by Herr A. Koeltzow records on a cylinder made of a kind of hard soap. Each cylinder costs only about seventy-five cents, and can be used for 250,000 words, owing to a device for removing a thin layer from the surface when it has been completely covered. Thus the cost does not exceed that of the paper required to write an equal number of words.

The Potential and Current Curves of Different Types of Alternators, and Their Influence on the Candle-Power of Alternate-Current Arcs.*

BY G. RÖSSLER AND W. WEDDING.

In working alternate-current stations it has repeatedly been observed in recent times that arc lamps which have been adjusted with every care in the factory had to be readjusted when in working, in order that they might burn quietly at the same pressure and current. The cause of this phenomenon, as was soon recognized, lies in the differences of the periodic potential-waves of the machines with which they were tested from those with which they were run. Should these curves appreciably differ, as may easily be the case if dynamos and lamps are not supplied by the same firm, it may even happen that a well-regulated lamp, when tested, cannot be made to burn quietly when run on a different machine. This fact renders it necessary in building alternators for arc lamp supply to attempt always to produce a definite particular form of E. M. F. wave.

In choosing this form of wave two conditions must be considered. Firstly, how does the lamp burn? and secondly, what illuminating power does it possess when run with different character of potential and current waves? An answer to these questions can only be obtained experimentally by simultaneous electrical and photometric observations on machines and lamps at present in use. The authors made together such researches in the Electrotechnical Laboratory of the Technical High School in Berlin at Easter, 1894. The electrical portion is the work of G. Rössler and the photometric of W. Wedding.

PART I.—ELECTRICAL.

Three machines were available for the following experiments, a 5½ kilowatt machine, by Ganz & Co., four polar, with a rotating cross-formed armature (Fig. 1); an older small 480-watt machine, by Wechsler & Co., with four magnet poles on each side of the rotating armature (Fig. 2), both machines the property of the Electrotechnical Laboratory; and, besides these, a machine by Siemens & Halske, with twelve poles, specially built for their own use for the preparation of ozone (Fig. 3), and which was very kindly placed at the authors' disposal by the firm. The arc lamp used was an excellent one, coming from the works of Messrs. Körting & Mathiesen, of Leipzig.

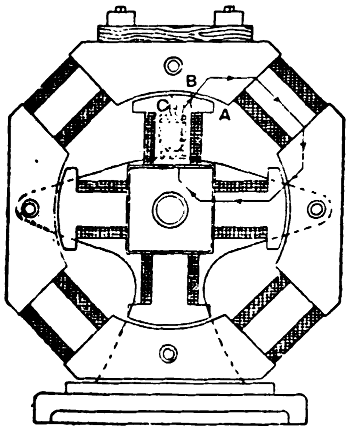

FIG. 1.

The determination of the curves of potential and current given by the machine was effected by the method described in principle by Joubert in his researches on a Siemens machine in 1881; one terminal of a voltmeter is joined to a terminal of an arc lamp, while the other terminals of voltmeter and arc lamp once in every revolution are connected together at a definite moment in the period. After suitable calibration of the voltmeter one can measure the potential difference for every position of the armature, and the current is measured by the fall of potential across a suitable known inductionless resistance.

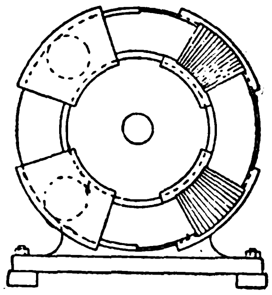

FIG. 2A.

In our case this momentary contact was produced as follows (Fig. 4): A contact block, A, imbedded in the surface of an insulating ring which rotates with the shaft, was permanently connected with the flat brass ring C and the brush D, and touched once in every revolution the brush B, which, carried on an insulating brush-holder, E, could be moved over the periphery of the divided arc F. B is permanently connected to one terminal of the voltmeter and D to a terminal of the lamp or resistance; B could be connected with D at any particular point in the period by moving the sliding brush-holder E over the arc. For the practical work of observation the mechanical construction of the contact A B is of the greatest importance and may easily become a source of many errors and much waste of time. The material known as stabilit, recently introduced by the Allgemeine Elektricitats Gesellschaft, was used for the insulating ring because of its excellent insulating properties, and its surface took quickly a beautiful polish under the action of the brush B. The measurements were made with an electrometer by Carpentier, which was very dead beat owing to its needle being suspended as a copper ring in a very strong magnetic field. In order to avoid variations in the reading of the electrometer a Siemens mica condenser of one microfarad capacity was put in parallel with the electrometer. The discharges which take place owing to imperfect insulation when the contact A B is broken do not affect the potential difference of a condenser of this capacity to an appreciative extent; and, similarly, the condenser obliterates all irregularities in the driving of the machinery. The system of coupling the electrometer was as in Fig. 5. One pair of quadrants is connected with the needle and one terminal of the volts, the other pair being connected to the other terminal. The turning moment is then proportional to the square of the potential difference. And since in the Carpentier instrument the control is obtained by twisting the suspension, and this force is proportional to the angle of twist, it follows that the angle of deflection is proportional to the square of the potential difference.

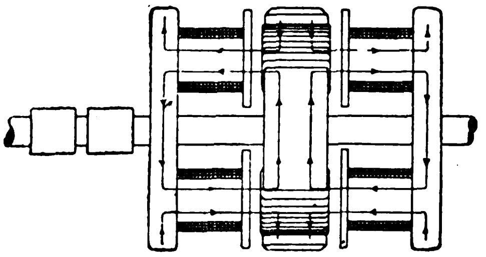

FIG. 2B.

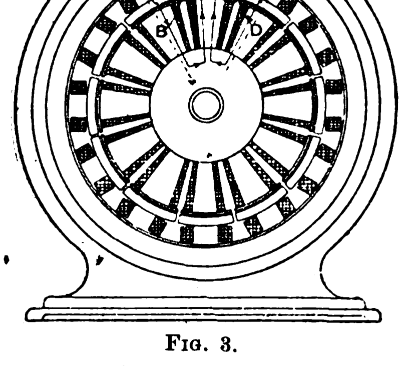

FIG. 3.

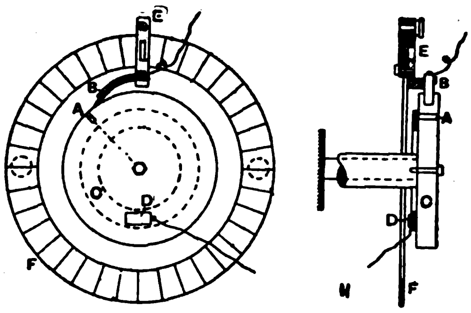

FIG. 4.

The lower readings are, therefore, less sensitive than the upper, and the lower limit of this instrument was about 20 volts. For the determination of smaller potential differences the needle was separately charged, as shown in Fig. 6, to about 100 volts. The deflection is then proportional to the potential difference between the quadrant pairs: 1 volt gave 20mm. deflection. Special switching arrangements enabled the coupling to be altered at any moment and the electrometer and condenser to be discharged.

In calibrating the electrometer several important points must be noticed. The torsional rigidity of the suspension depends on the temperature, and, therefore, also the constant of the instrument. As the axis of rotation of the needle is unalterable by the construction of the instrument, a completely symmetrical position of the needle with respect to the quadrant is seldom attained. This has the disadvantage that the position of the needle alters when charged as in Fig. 6. To avoid the difficulties introduced by trying to treat the Carpentier instrument theoretically, the instrument was empirically calibrated over all its range, and this calibration was repeated before each set of readings. An easy and convenient means of doing this was at hand in the form of a Feussner compensator with Clark standard cell, and a second small Pollak

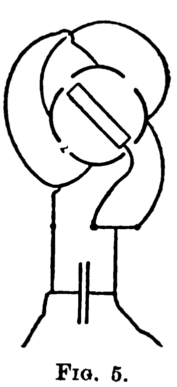

FIG. 5.

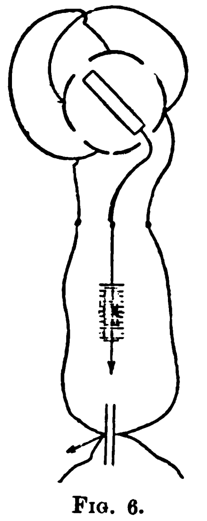

FIG. 6.

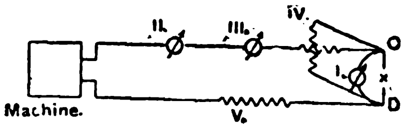

FIG. 7.

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* Abstract of paper read before the Verband der Elektrotechniker Deutschlands, 1894.

accumulator battery of 100 volts. As is well known, one can easily produce in the main circuit of this compensator, by the aid of the Clark cell, small currents, as ·01 ampere, with the greatest accuracy. By an arrangement for switching known resistances into the circuit any voltage can be quickly produced.

Since the charge occupies only a small proportion of the whole time, it is necessary to calibrate by means of known voltage applied to the same rotating contact, so as to accurately reproduce the conditions. Much has been written by Hopkinson and others on the subject of the suitability of certain instruments for such measurements, but an empirical calibration of this sort immediately renders us independent of the peculiarities of the instruments used.

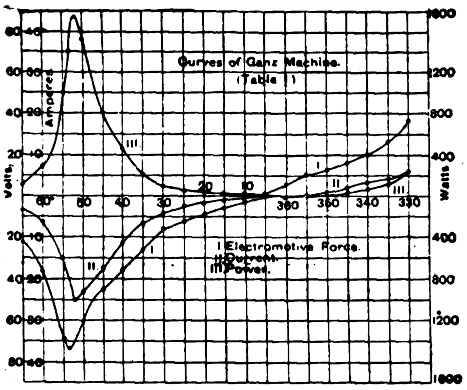

FIG. 8.

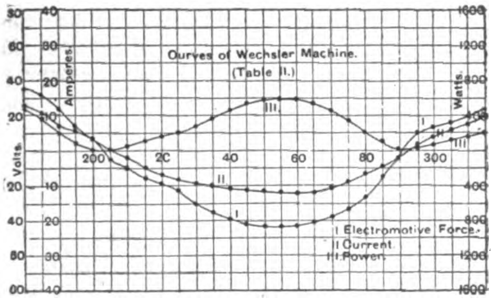

FIG. 9.

Besides the electrometer the following instruments were in circuit (Fig. 7):

1. A Cardew voltmeter in parallel with the lamp C D.
2. A Thomson balance reading 0·1—10 amps.
3. A Schuckert alternate current ammeter.
4. A Ganz wattmeter.

The inductionless resistance (5) was used in conjunction with the electrometer for the determination of the current curve. The instruments 1 and 3 measured the square root of the mean square of current and volts; the wattmeter (4) gave the power. The Thomson balance was only used in regulating the lamp, the Schuckert ammeter being used for keeping the current constant.

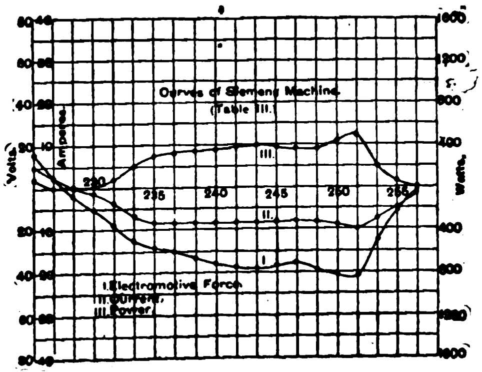

FIG. 10.

Measurements on the electrometer were only made when the signal was given that the lamp was burning normally. As the feed takes place in jerks the electrometer reading is not steady, and therefore ten observations of currents and volts were made for every position in the period. Altogether during the photometric measurements four pairs of curves were taken on the Ganz machine and two pairs on each of the others; but, as these are all in perfect accordance, only one set need be given for each machine. In the following tables the results of the last set of observations on each machine are given. The values therein given, and graphically represented in Figs. 8, 9 and 10, are obtained from the electrometer readings by subtraction of the total current and total power taken by the Cardew voltmeter and the wattmeter shunt.

Discussion of the Results.—The periodic variation of the electrical magnitudes is very considerably different in the three machines used. The Ganz machine has a quickly rising and quickly falling wave, the ordinates rising rapidly to an extraordinarily high point, falling rapidly, and remaining for the greater portion of the period at a very low value. So that the value of the energy supplied to the lamp (Curve III.) is very small from 35°—335°, and nearly the whole supply takes place over the range 35°—65°. The lamp, therefore, receives its energy in the form of an impulse lasting only about a third of the whole time. The reverse of this is the case of the Siemens machine (Fig. 3). Here the energy rises very slowly to a maximum value, on which it waits for some time, then declines slightly, rises again more sharply to a still higher value, and then falls quickly to zero. The current curve is even more regular, remaining constant in value for more than half the half period.

The Wechsler machine takes an intermediate position; there is no very rapid alteration of the ordinate, and, on the other hand, no sustained maximum. This machine comes very near to having a sine wave.

The general character of these curves is easily explained on the theory of electro-magnetic induction from the magnetic design of the alternators. It is more difficult to follow in detail the reaction of the armature on the magnetic field and thence on the volt and current curves. As the types of alternator here used are of special interest as extreme types of what may occur in practice as regards electrical properties, some account must be given of the cause of these properties.

The investigation of the induction processes is best conducted on Faraday's lines of force theory (1) according to the known fundamental laws. If a closed conducting circuit be moved in a magnetic field an E. M. F. is produced whose value in absolute units is the rate of change of the number of lines cutting the plane of the circuit; (2) using the law of the magnetic circuit of these lines, according to which a certain magnetizing force, determined by the ampere turns, always produces in a magnetic circuit a certain definite number of lines of force, inversely proportional to the magnetic resistance as calculated by certain definite rules. With these laws as starting point, the phenomena of the induction in these machines may be explained as follows:

1. The Ganz machine (Fig. 1), armature and magnets made of charcoal iron, with armature and magnet poles of solid metal. Four magnetic circuits, taking the course shown for that position of the field magnets, the lines of force coming out of the right hand side of each limb, and passing in again on the left hand side of the next limb. A rotation of one-eighth of a revolution to the right may be divided into three parts. First, from the position drawn until the position is reached where the area taken up by the induction coming out is halved (when the point B is opposite A). The path of that going in becomes wider. The magnetic resistance of the circuit, and therefore the number of lines of force, is but little altered, and thus the induced E. M. F. is small. Second part: From this last point to that at which the left edge of the magnet pole is separated from the right edge of the armature projection by half the width of the pole face (point C, opposite A). On this part of the curve the lines of force coming out of the magnet into its pole-piece bend over into its left half, and the right half gets out of range. At the end the total area for the lines coming out and going in is equal to the area of the magnet limb. The magnetic resistance becomes somewhat greater, the number of lines of force diminishes slowly, the E. M. F. goes slowly up. Third part: From the end of the second part until the middle of the magnet pole is opposite the middle of the armature coil. In this short stretch the area of the induction path becomes rapidly smaller, the magnetic resistance rises, the number of lines of force diminishes, and the E. M. F. increases rapidly. During the second eighth of a revolution of the magnet the E. M. F. diminishes again in a symmetrical manner.

2. The Wechsler machine (Fig. 2A). Eight magnetic circuits, four on each side of the armature. Path of the magnetic lines as in Fig. 2B, as similar poles are opposite to one another. Smallest alteration of the number of lines is obviously when the armature coils are in the middle between two poles, and therefore zero of E. M. F. in this position. Greatest alteration when in the position shown in Fig. 2A, and therefore maximum E. M. F. here. In moving from one of these positions to the other there are no sharply marked divisions of the movement. The crossing of the induction from the magnets into the armature will always take place with great smoothness when the polar surfaces are divided from the armature iron by a large air gap, and this occurs in the Wechsler machine. The principle of large air gap is a useful one where sine curves of E.M.F. are to be aimed at; the only important objection is the lowering of the electrical efficiency, but in America good dynamos are built with air space up to 15mm.

The Siemens machine (Fig. 3) gives a view of the magnetic circuits of the machine supplied by Siemens & Halske, as far as could be determined in the laboratory without taking the machine to pieces. The twelve magnet limbs, arranged as a star, come opposite as many armature coils wound on iron. Two of the magnetic circuits are indicated in Fig. 3. The pole pieces of armature and magnet are so wide that the edges of neighboring pole pieces are very close together, and herein lies the cause of its different pressure curve. If we again assume that in Fig. 3 the magnetic lines are coming out of the right hand side of the magnet limb and passing into the left hand side of the next, there exists when the armature is turned round no position where the number of lines of force suddenly alters. The rotation by a quarter period may be divided into two portions:

First part: The magnet turns to the right between the pole pieces of the armature, until B comes in front of A, and then D is also near C. During this part of the revolution the magnetic resistance increases, the lines from each magnet limb pass into two armature coils, and in the armature one portion of the induction is opposed to the other; the result being during this portion of the revolution an increasing diminution of the lines of force—that is, a rising E. M. F.

Second part: When B turns further out past A, D passes out over C, the path of the induction coming out of the limb B into the armature coil A becomes steadily narrower, and the lines coming from B pass half into A and half into C, when the induction cutting the armature coils is 0. During this second half of the revolution this induction alters more rapidly than in the first part, resulting in a slowly rising E. M. F., which sinks again symmetrically as the rotation is continued.

The above considerations show afresh how extremely important the shaping of the pole pieces for a given type of machine is in determining the character of the periodic curves of the electrical quantities. We have considered only the influence of the magnet fields, and the curves would be symmetrical were no other influence active. The deviations from symmetry are due to armature reactions weakening the field when approaching and strengthening it when receding. To enter in detail into this effect is beyond the scope of the present Paper.

The accuracy of the above curves may be tested by comparing the average values obtained from them with the readings of the voltmeter, ammeter and wattmeter. A wattmeter reads the average value of the watts, while the voltmeter and ammeter read the square root of the mean square, and this must be taken into account in measuring the curves by planimeter.

The comparison comes out as follows:

MACHINE.	Volts.		Amperes.		Watts.	
	Measured.	Calculated.	Meas. ured.	Calculated.	Measured.	Calculated.
Ganz........	29·9	29·6	9·49	9·06	267	264
Wechsler	31·1	31·8	9·50	9·25	298	293
Siemens......	30·4	30·8	8·87	8·81	—	—

In the first two cases the photometric and electric measurements were simultaneous; in the last the electrical measurement directly preceded the photometrical, and the wattmeter was not read. The result is a closer agreement with the observed values.

A closer agreement could not be expected when driving so unsteady a load as an arc lamp. It must be noted that the phase displacement is very small, only about 1-18th of a half period. For the recognition of the nature of the arc, the determination of the cause of this small displacement is of great importance; for to prove that it took place at the arc itself would be to prove an E. M. F. in the arc. The question whether this back E. M. F. were due to self-induction or to an electromotive force in the arc itself would still remain unanswered. The experiments do not throw much light on the subject, as the back E. M. F. of the coils of the lamp cannot be accurately calculated. The only thing they prove is that no great phase difference exists in an arc lamp.

Influence of the Character of the Waves on the Regulation of the Arc Lamp.—The discussion of this question is best preceded by a short description of the arrangement of the lamp. It is a differential lamp, and its construction is indicated in Fig. 11. The two coils are over one another, the current coil A above, the pressure coil B below. The two carbons of equal thickness hang on the ends of a chain passing over the chain wheel D. As the carbons burn away the rotation of D brings them together, and as they burn equally they are raised and lowered by equal amounts, thus remaining about in the same position as regards the reflector *e*. To regulate the lamp the coils each work on a split iron tube, *a* and *b*, which are both fastened to a brass rod, *c*, hung on the end of a three-armed lever, E. These tubes are symmetrically placed when E is horizontal, and their working is independent of any difference of phase in the currents which attract them. The working is as follows: When the current passes through the lamp, the carbons being together, the current coil working alone pulls E down. The vertical arm F of the lever moves to the right, and by means of the connecting rod G moves H and D round the axle *e*, and draws the carbons apart. But H and D are only coupled together when arm J is pushed against K by the movement of H sideways. When the required pressure is attained the pressure coil lifts its core and feeds the carbons; the movements are made steady by a dash-pot L, whose piston can be weighted to control the regulation of the lamp.

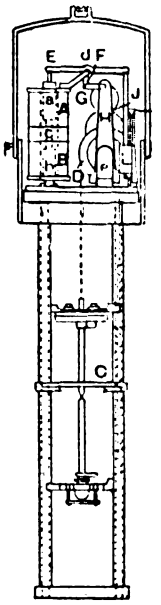

FIG. 11.

These weights had to be altered considerably for the different machines, being heavier for the Ganz and lighter for the Siemens machine; while with direct current the weight could not be sufficiently reduced to start the arc properly. This latter phenomenon is obviously due to the self-induction of the pressure coil, and resistance should be put in its circuit when used on direct currents. This also accounts for the differences between the machines, owing to the variations in shape of the E. M. F. curve. The author also gives reasons for working at a low-induction density in the iron cores if the lamp is to work on as many different kinds of machines as possible.

Storage Battery Traction in Paris.

The accumulator cars, which have been running for some time on the lines of the Northern Tramways Company of Paris, appear to be proving fairly satisfactory, as the cost is reported to work out at about the same as horse power on the Paris lines. The cars are arranged to seat fifty-two persons, and run at a speed of about 7½ miles an hour within the city limits, which outside is increased to 10 miles. Inclines of about 4 per cent. have to be mounted at certain parts of the line, and each car runs 80 miles a day. The motive power is supplied by a battery of 108 cells, having eleven plates each. These cells are fitted into twelve cases. They are coupled in four groups of twenty-seven cells each, the electromotive force of each group being about fifty volts. The groups can be arranged either in parallel or series, so that a wide range of speed is at the service of the driver. The two motors which drive the car can also be coupled in series or parallel. The total weight of the car with accumulators and passengers is twelve tons, the weight of motors and accumulators being about four tons.

Characteristics of a Popular Railroad.

Travelers find unexcelled accommodations and supreme comfort on the cars of the New York Central Railroad. American railways are noted for the advantages which they afford the traveling public, and there are none that surpass this splendidly equipped road.

The Electrics of the Atmosphere.*

BY E. O. WALKER, C.I.E., M.I.E.E.

It is surprising to notice in the *Electrical Review* of the 20th ult. a quotation from a paper by Börnstein, in the *Annalen der Physik und Chemie*, in which it is stated that the results of observations go to prove that the potential of the atmosphere decreases with increasing height. It has generally been held to be otherwise. High potentials have been found on the summit of Teneriffe, on the peaks of the Rocky Mountains, and on the Eiffel Tower. Prof. Elihu Thomson refers in a recent lecture also to the Washington Monument as a case in point. It is true that these observations have been taken at points near to, or connected to, the ground, and the high potentials may be due to differences in atmospheric pressure at different points of the earth's surface. Apart from that surface and in mid-air, the conditions may be different. However, we should reasonably expect to find, if electric waves proceed from the sun, that they would first become sensible when they impinge upon the higher atmosphere of the earth, that there the tension would be greatest, and that lower down refraction and reflection would result in dispersion, mutual interference and consequently a decrease in tension. Until more observations are taken, as suggested in the *Review*, by balloon, and under different conditions of weather, and in different localities, the view that elevation and high potential subsist together will, I think, continue to prevail generally. One of the most ordinary phenomena of frigid regions, the aurora, seems to depend for its *raison d'être* upon the path from the upper atmosphere to the earth being made conductive by intense cold and rarefaction, and permitting of brilliant electric discharge.

It is encouraging to know that the actual electric properties of the air are gradually being elucidated by such complete and convincing experiments as those of Lord Kelvin and Magnus Maclean recently (May 9th) brought before the Royal Society. Here pure air is found capable, as well as smoky or dusty air, of being electrically charged, and it seems that it retains a considerable portion of such a charge for several hours. It is worth while to quote what is said as to the normal condition of the air at and near the earth's surface. "The out-of-doors air potential . . . . was generally positive, and the earth's surface itself therefore, of course, negative—the common fair weather condition—which I am forced to conclude is due to a paramount influence of positive electricity in higher regions of the air, notwithstanding the negative electricity of the air in the lower stratum near the earth's surface." Again ('Electrostatics and Magnetism,' Art. XVI., Section 282), "even in fair weather the intensity of the electric force in the air near the earth's surface is perpetually fluctuating during calms, or very light breezes from the east, varying from 40 Daniell's elements per foot to three or four times that amount during a few minutes, and returning again as rapidly to the lower amount. . . . These gradual variations cannot but be produced by electrified masses of air or cloud floating by the locality of observation." Further on the authors write: "It is interesting to remark that negatively electrified air over negatively electrified ground, and with non-electrified air above it, in an absolute calm, would be an unstable equilibrium, and the negatively electrified air would therefore rise, probably in large masses, through the non-electrified air up to the higher regions, where the positive electrification is supposed to reside. Even with no stronger electrification than that which we have had within our experimental vat, the moving forces would be sufficient to produce instability comparable with that of air warmed by the ground, and rising through colder air above."

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* *The Electrical Review*, London.

The part played by moving dust particles in our atmosphere is not touched upon, but they must go far to modify the conditions existing in pure air; it is not impossible that the electrification of such particles determines condensation and precipitation of vapor, and it is to be hoped that Mr. Aitken, who has devoted so much time to the study of dusty atmosphere, may complete our knowledge of its properties. There is in the electrical state of the atmosphere a condition which must so profoundly affect the health of the people, that we cannot afford to postpone its thorough investigation.

As a result of observations made in India between 1881 and 1888, I hazarded the conjecture that difference in atmospheric pressure at any two points would occasion an "earth current" if the two were joined by a wire, and the idea was more particularly brought forward and supported by evidence in a paper read by me in 1893 at the Institution of Electrical Engineers (Part 105). It did not seem to find acceptance, because the *rationale* of the process did not cover as well magnetic variations.

I think now it will be admitted, after a perusal of the paper of Lord Kelvin and Magnus Maclean, that there are two entirely distinct phenomena to be dealt with, and those who undertake to investigate "earth currents" must be prepared to find the two sometimes operating together and sometimes separately. The quietly and gradually changing earth currents, often found in India, particularly between inland places and those on the sea coast, or between places of different elevation, are due to the changes in electric potential of the atmosphere, which accord with Lord Kelvin's observations; the currents are the stronger when the atmospheric pressure is changing more rapidly at the one place than the other, for instance, at a highland and a lowland station; that is, when the effect of solar radiation is communicated at a quicker rate at the one place than the other. The tendency is, when the two places are joined by a conductor, towards equilibrium of electric pressure at both ends, but since the forces producing the difference of potential are in continual operation there is a current. I have very often experienced a difference of 2 volts, often less, sometimes 5 volts; in the cable, Madras to Penang, over 14 volts have been observed. I am referring now to quiet days when the magnets are not abnormally disturbed, and I have shown in my paper of 1893 that these "electro-atmospheric" currents only gradually change in force. It is very likely that the observations on Ben Nevis may show the same class of phenomenon. When clouds condense there, or rain or snow falls, a current flows from the summit to the base, and the direction is reversed as the cloud leaves, the mists rise and moisture is re-evaporated. In dry air, and in the absence of vapor, we must now accustom ourselves, in the light of Lord Kelvin's experiments, to believe that the same process goes on when movements of the air are occasioned by differences of temperature and so of pressure.

Quite a different phenomenon would appear to be that affecting a suspended needle in its daily variations. The force is so small that its effects in creating currents in our telegraph lines are on most days obscured by those of "electro-atmospheric" potential. It is not impossible that it may be attributable to the lagging behind in high regions of magnetized crystals of frozen oxygen, and the incessant evaporation and re-arrangement of these crystals under the action of solar heat. According to the position of the earth relative to the sun the direction of the lines of these crystals would vary and cause a distortion of the earth's magnetic field, varying according to time of day and season of the year, and a consequent modification of the position of the needle. Some color is lent to this hypothesis from the fact that the curves of declination at Madras vary with the position of the sun north and south of that place. But can large disturbances, such as produce violent currents in our wire circuits, simultaneously with swinging of the needles, be accounted for either by greater "lagging behind" or irregular movement of magnetized matter in the upper atmosphere? There seems to be no evidence to prove it, and it can only be hoped that the close attention given to the question by Mr. William Ellis, F. R. A. S., may be applied without intermission to the elucidation of the mystery, and that the question may be studied intimately and concomitantly with solar physics. In Mr. Ellis's paper, read before the Royal Society on May 5, 1892, he showed how, by actual observation definite and rapid movements of the magnets occur at times of disturbance simultaneously, or nearly so, all over the earth. The observations were taken at Toronto, Greenwich, Pola, Pawlowsk, Mauritius, Bombay, Batavia, Zi-ka-Wei and Melbourne. At Greenwich, Mr. Ellis says, such sudden magnetic movements are always accompanied by corresponding earth currents. We know that the solar diurnal variation for each place takes place according to local time, that is, the needle moves on its even sweep later at places west than at places east, so that the unusual magnetic impulses cannot be merely an increase or decrease of the force ordinarily causing variation, but a manifestation of a force of another character, by which the intensity of the earth's magnetic elements is increased or decreased suddenly from the normal.

I cannot help noticing, in conclusion, that Mr. Ellis, speaking from his experience of the Greenwich Observatory earth current lines, says that the "diurnal magnetic variation of declination or horizontal consists principally of one bold daily sweep, has no corresponding earth current, being accompanied principally by alternating currents, weak in character, and generally of short period. . . . In the absence of magnetic disturbance there exists practically earth current calm." That is, the lines are so short and the atmospheric conditions at Greenwich are so similar to those at the other terminals of the lines, that there are no "electro-atmospheric" manifestations, and that, except during "magnetic storms," only feeble thermo-electric currents, and those due to mechanical concussions in the neighborhood of the earth plates, are observed.

In the study of these most interesting subjects we shall hope to see all the factors that contribute to make the phenomena complex, evolved, and the *modus operandi* of each explained. There can be no doubt that in much that has been written and discussed in the past observers have unintentionally been confusing different causes and effects.

Cable vs. Electricity.

In a recent discussion on electric railroading, an instructive comparison of the relative efficiency of electricity and the cable for power transmission was thus embodied in figures: A steel cable one and one-half inches in diameter, traveling twelve miles an hour, can transmit nearly 2,000 horse-power. A copper wire with a section of one square inch will carry an electric current of 10,000 volts, at 1,000 amperes to the square inch, and such a current is now being transmitted in this country. This is equal to 18,000 horse-power, which is enough to instantly rupture six cables such as are ordinarily used in cable traffic.

A Phonographic Method for Recording the Alternating Current Curve.

BY C. J. ROLLEFSON.

In this paper it is intended to give only a short description of a method devised by the writer for the study of alternate current phenomena. After a number of devices had been tried, the use of the phonograph suggested itself. The phonograph records vibrations of sound, which are similar to the vibrations produced by an alternating dynamo, and reproduces the quality of the sound to such a high degree of accuracy that it seems that it might prove an accurate instrument for recording the alternating current curve.

The method, in brief, consists of two operations: first, a record of the curve must be produced on the wax cylinder of the phonograph; second, the indentations produced on the cylinder in the first operation must be magnified by means of a suitable multiplying arrangement.

A section of the arrangement for producing a record of the curve on the wax cylinder is shown in Fig. 1. A small steel magnet, *a*, is fastened to the center of the glass diaphragm, *b*. Around a small bundle of fine iron wires, *c*, are wound a few turns of insulated copper wire, the small electro-magnet thus made being fastened in front of the small steel magnet attached to the diaphragm. Turning the cylinder, *C*, of the phonograph, and passing the alternating current through the coil of the electro-magnet, the small steel magnet, *a*, is alternately attracted and repelled, and the vibrating motion thus produced transmitted to the diaphragm, *b*, and the sapphire-arm, *l*, and thus indentations corresponding to the vibratory motion of the small steel magnet are produced on the wax cylinder.

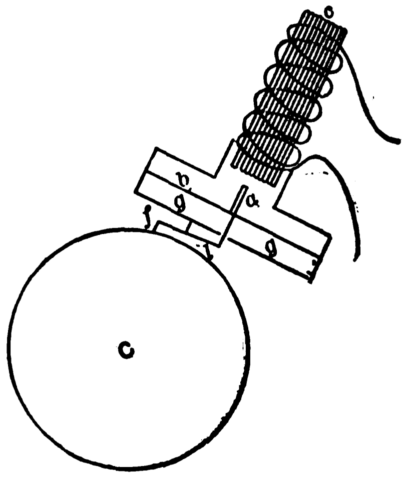
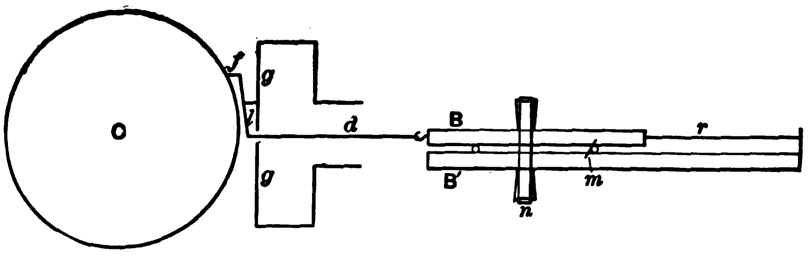


FIG. 1.

The first operation is now complete; it remains to magnify the indentations produced on the wax cylinder. A section of the apparatus which has proven successful for this purpose is shown in Fig. 2. Two small brass bars, *BB'*, are taken, the lower one being fastened rigidly to the diaphragm arm (not shown in the figure), and the upper being free to move. A rubber band, *n*, passing around the two bars holds the upper bar in position. Between the bars are placed two small rollers of very fine iron wire. To the end of one of the rollers is attached a small mirror, *m*, so that readings may be taken with a telescope and scale. The glass diaphragm is removed, and a fine wire, *d*, fastened to the sapphire-arm, *l*, and to one end of the movable bar, *B*. At the other end of the movable bar is fastened a rubber band, or spring, *r*, which serves to keep the reproducing-stylus, *f*, pressed against the wax cylinder. The producer-weight, *g*, to which the sapphire-arm is attached, is now fastened; otherwise this weight would move and the movable bar remain stationary. The wax cylinder, *C*, is then turned successively through a very small angle by means of an arrangement not shown in the figure, and readings taken.

Only a few preliminary experiments have been performed, but the results obtained seem to be very promising. That the curve should be absolutely perfect is, of course, not to be expected when inertia must be taken into account. The writer believes, however, that inertia does not play an important part in this method. The movement of the glass diaphragm when the curve is recorded on the wax cylinder may be made so small that the indentations produced on the cylinder are scarcely visible to the naked eye. In the second operation inertia does not enter, as there is no motion of any of the parts when the readings are taken.



A PHONOGRAPHIC METHOD FOR RECORDING THE ALTERNATING CURRENT CURVE.—FIG. 2.

This method seems to be especially adapted for the study of harmonics in the alternating current. By the aid of König's apparatus the number of harmonics present may be determined, and perhaps, their relative intensities. Then, by plotting the curve, their relative positions may be determined. These operations may be repeated several times, and thus each operation serve as a check on the others.—*Physical Review.*

On Magnetization Produced by Hertzian Currents—A Magnetic Dielectric.*

BY M. BIRKELAND.

"Two years ago it was proved by conclusive experiments that Hertzian waves traveling along an iron wire magnetize transversely the very thin layer into which the alternating current penetrates, and whose thickness does not exceed some thousandths of a millimeter. Once proved that alternate magnetization can be produced with such rapidity, other questions present themselves. One asks, for instance, if it is not possible to demonstrate in magnetic cylinders stationary magnetic waves analogous to the electric stationary waves along metallic wires."

The author finds that the conductivity of massive iron makes it an unsuitable substance, and uses instead a mixture of iron filings, or of chemically-obtained iron powder, with paraffin, to which he sometimes adds powdered quartz. This he moulds into cylinders, and inserts as the core of a spiral in an otherwise ordinary Hertz resonator.

The figure shows emitter and receiver drawn to scale, the magnetic cores are introduced into the spiral A, and their effect on the length of the resonator spark is observed. With this arrangement of exciter the *electric* effect of the spiral is negligible, since it is well removed from electrostatic disturbance and subject only to magnetic. The spiral is of twelve well-insulated turns, the spark-gap is a micrometer with point and knob, and a pair of adjustable plates to vary the capacity for purposes of tuning.

He employed twelve different types of cylinder, all about 20cm. long and 4cm. diameter.

1. A massive cylinder of soft iron.

2. A bundle of fine iron wires embedded in paraffin.

3—9. Six cylinders of the agglomerate of chemically-reduced iron in powder and paraffin, containing respectively 5, 10, 15, 20, 25 and 50 per cent. of iron.

Then for control experiments:

10. A cylinder of agglomerate of zinc powder in paraffin, with 40 per cent of zinc.

11. A cylinder of brass filings in paraffin, 20 per cent. of metal.

12. A tube of glass, 4·5cm. diameter, filled with various electrolytes.

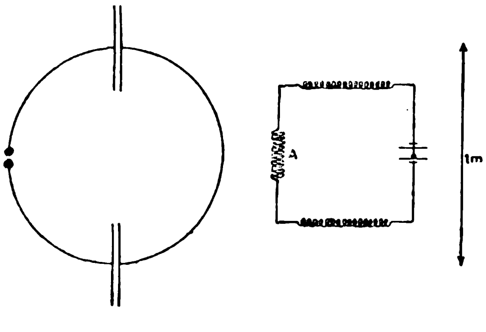
The manner of observing was as follows (the experiments were done in the laboratory of Hertz):

The resonator, with its spiral empty, was syntonized with the exciter and the maximum spark measured. It was between 4 and 9mm. long in these experiments. Then one or other of the above cylinders was introduced and the spark length measured afresh.

Cylinder 1 did not affect the maximum spark-length. Cylinders 2—4 reduced the maximum spark to $\frac{1}{10}$th of its former value; 7 and 8 to $\frac{1}{100}$th, and No. 9 to $\frac{1}{200}$th of its former value (viz., from 9mm. to 0·05mm.). Nos. 10 and 11 had but a feeble action; they reduced the spark from 8mm. to 7mm.

Tube No. 12, filled with distilled water, scarcely affected the spark-length; the period of the secondary increases a little, but the maximum spark is the same as before, once syntony is re-established. Filled, however, with dilute sulphuric acid containing 10, 20 or 30 per cent., the tube reduced the spark considerably, in each case about the same, viz., from 9 to 1·3, about. (Currents induced by Maxwellian radiation in electrolytes had been already observed by J. J. Thomson.)

While trying to re-establish syntony between primary and secondary, I found that the period of the resonator was considerably increased by the cylinders 2—4, but that the maximum spark-length was much diminished. With the cylinders Nos. 5—9 in the spiral, it was no longer possible to establish syntony, "a fact which is certainly due to their considerable absorption of energy. Take, for example, cylinder 9: electromagnetic energy must converge rapidly towards it in order to be transformed, and the space finds itself empty of energy as air is exhausted of vapor in presence of an absorbing substance.



"This absorption is probably due to hysteresis in the ferruginous cylinders; the development of Joulian heat, so typically shown by cylinder 12, being undoubtedly of the same order in cylinders 3—9 as in Nos. 10, 11.

"It is probably by reason of this absorption that I have not succeeded in establishing stationary magnetic waves in a circuit of ferro-paraffin."

If one of the cylinders, 2—9, is wrapped in tinned paper before introducing it into the spiral A its action is completely stopped. (These conducting cores *diminish* the period of the resonator; it is much as if the spiral A were partially shunted out; but the maximum spark returns as soon as syntony is re-established.) To examine this further he enclosed the cylinder in drums of cardboard having fine wires either along generating lines or along circular parallels. The latter suspended the action of an interior ferruginous cylinder, the former did not.

To find to what depths the magnetism penetrated, Birkeland inserted hollow ferruginous drums into A, measured their effect, and then plunged solid cylinders into them to see whether the effect increased.

He thus found that the magnetization easily traversed 7 millimeters thickness of the 10 per cent. ferro-paraffin and 5 millimeters of the 25 per cent.

The substance is comparable to a dielectric on the theory of Poisson-Mossotti.

"The results obtained with our magnetic dielectric invite to new researches"—such as the mechanical force excited by electric waves on a delicately suspended ferro-paraffin needle, and the rate of propagation of Maxwellian waves through such a substance.

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[*] Abstract from *Comptes Rendus.*

The Electrical Repulsion of Solutions.

If an attempt be made to pass a current of electricity through, for example, arsenious sulphide solution, the sulphide will be repelled as a whole from the negative electrode, and also to a certain extent from the positive electrode, without appreciable electrolysis. This fact, says the London *Electrical Review*, was observed a year or so ago by S. E. Linder and H. Picton in an investigation on "Solution and Pseudo-solution." They have now examined a large number of different solutions showing characteristic electrical repulsions. Thus aniline blue is repelled from the negative electrode, magdala red and methyl violet from the positive; sulphur and iodine from the negative electrode. It seems impossible to obtain repulsion in an absolutely non-conducting medium for instance, iodine in carbon disulphide is not repelled. Again, in doubling the strength of arsenious sulphide, the rate of repulsion is approximately halved. Indigo in water is repelled from the negative electrode, in naphtha it is not repelled. It was found that, in general, when solutions exhibiting opposite repulsions are mixed, complete coagulation of the dissolved substance occurs. Under certain conditions of dilution the coagulation may be avoided, and the aggregates of this mixture are repelled as a whole from one electrode. By adding a new solvent the mixture is caused to be dissociated, and the aggregates are repelled individually from their characteristic electrodes. Such are some of the results obtained up to the present. More are to follow, and as some of the best scientists have expressed their interest in the particular line of research which is being followed, it is reasonable to expect that there will be some valuable conclusions drawn from it, which cannot but throw some light upon the relations existing between chemical affinity and what, for want of a better term, we call "electricity."

A Course of Electrical Lectures.

A course of twenty-five lectures on Electrical Engineering, by Mr. Max Osterberg, E. E., graduate of Columbia College, will be given on Saturday evenings, beginning October 6, 1894, in the Young Men's Christian Association Building, corner 23d street and Fourth avenue. Tickets $6. For further information apply to educational secretary, Waldo H. Sherman, 52 East 23d street, or to Mr. Osterberg, 232 East 62d street, on or before October 1, 1894.

Electric Railway Consolidation.

For some time past the People's and the Electric Traction Companies of Philadelphia have been considering a plan for the consolidation of these street railway systems into one corporation, and this scheme, it is stated, is practically adjusted.

It is not proposed that either corporation absorb the other, either by way of lease or sale of a controlling interest. A consolidation which would mean the annihilation of either could not be accomplished under the law. The plan suggested is somewhat similar to that by which the People's Traction Company obtained control of the People's Passenger Railway Company.

By that plan the control is secured by ownership of nearly all the stock of the Railway Company, which was purchased by the Traction Company at $75 per share, $5 in cash and $70 in trust certificates. These certificates are issued by a trust company and are secured by deposit of the shares of the People's Passenger Railway Company, and by contract of the People's Traction Company, which guarantees payment of principal and interest, if the dividends which are earned on the railway company stock are not sufficient for the purpose. The People's Traction Company joins with the trustee in the execution of the certificates.

President Sullivan, of the Electric Traction, unqualifiedly denied that the Electric Company intended to purchase the People's Company. The talk of the "street" last week was full of the scheme and this was due to the persistent buying of the stock of the People's by representatives of firms that have been closely identified with the financiering and management of both companies. It was admitted by one of the parties interested that the principal difficulty in the way of the adjustment of the consolidation was the price at which People's was to be taken, and that the buying of stock was for the purpose of running the price up. This was denied by the People's brokers, who claimed that the stock was worth even more than the price at which it is quoted.

The consolidation of the two companies would represent a capital stock larger than that of the Philadelphia Traction Company. The combined roads run over about 200 miles of city streets, and when all the extensions are completed will occupy fully 250 miles, which is almost one-half of the street railway mileage of the city.

The proposed consolidation would embrace nine companies that a few years ago were operated independently.

Y. M. C. A. Educational Department.

There will be special exercises at the Young Men's Institute, 222 Bowery, New York City, Tuesday, Oct. 2, to formally open the educational department of the work. There will be music and short addresses in the large hall, and all the class rooms will be open for the inspection of visitors.

An excellent educational work is being done by the Institute each year. Instruction is given in the following subjects: Steam Engineering, Practical Electricity, Sanitary Plumbing, Carriage Drafting, Mechanical Drawing, Architectural Drawing, Freehand Drawing, Arithmetic, Bookkeeping, Penmanship, Shorthand, Typewriting, English Grammar and Composition, Vocal Music and Glee Club, and First Aid to the Injured.

The classes are open to all young men between the ages of 17 and 35 years. A distinctive feature of the educational work is that the theory is taught to those who are getting the practical part of the subject in their daily work. Firemen are taught all the theory necessary for becoming engineers. Engineers are prepared to take charge of higher grade engines. Machinists are taught the mechanical drawing which they need in their work, and young men in offices are taught commercial subjects. In this way the efficiency and commercial value of each student is increased for his present employer.

The enrolment for the season '93-'94 was 425 young men. The quality of work done has shown a decided improvement each year.

The school year continues until May when diplomas and prizes are awarded by the Committee of Management.

Admission is free to the opening exercises on October 2, and all interested are invited to attend.

"His Honor" Accused of Stealing Current.

There has been considerable friction for some time past between ex-Mayor Gleason, as proprietor of a trolley line in Long Island City, and the Steinway Railway Company, owners of a competing line of street railway, which culminated in an open rupture a few days ago when the Steinway officials charged Gleason with stealing electric current from their wires to run his cars.

Electrician W. E. Shephard, having heard that both of the dynamos in Gleason's power-house had been rendered useless by lightning burning out the armatures, and that Gleason's people had made a connection with the Steinway wires and were drawing current from them, got into his patrol wagon and set out on a tour of inspection. He found confirmation of the story, as he alleges, at the junction of Borden, Vernon and Jackson avenues, and speedily dissevered the offending wire and left some of Gleason's trolley wires trailing from the poles. The ex Mayor was soon apprised of this fact and mounting his wagon rode in hot haste to the spot. He was mad—much slighter causes have aroused his choler—but after fuming around for awhile he set his men at work repairing the damage. Shortly after they had restored the broken lines, the Steinway men returned, and were about to begin the work of demolition again, when the redoubtable Gleason rushed upon the scene like a meteor and threatened to blow the roofs off their heads if they dared to lay hands on his wires. Not wishing to expose their brains to the public gaze, they postponed further action and sent for the legal adviser of the company. On his arrival there was a scene—Gleason's abuse was showered on the whole Steinway Company and its officials, its workers, advisers and managers, in a torrent of words that curdled the blood of the spectators, but didn't seem to dismay the counsellor, who retorted in a way that provoked the ex Mayor up to the fighting point, and he was about to jump on the legal gentleman when an officer made his appearance and stopped the row. The Steinway electricians, however, didn't lay a hand on the Gleason "jumper" wire, but simply worked around their own wire, and cut and spliced it with ropes and wood until the current was dead. The Gleason cars made slow progress by the aid of an emergency dynamo.

Gleason denies that he was guilty of tapping the Steinway wires, and says that the wires cut by the Steinway electricians were on his road since it was built.

The Armour Institute.

This well-known institution occupies a place among the educational facilities of Chicago somewhat unique, but none the less important, and well deserves the approbation of all who have an interest in technical instruction. The department of electrical engineering is directed by Wilber M. Stine, M. S., Ph. D., whose qualifications render him well fitted for the place. This department includes Electrical Engineering, Laboratory Practice, Advanced Physics, Chemistry, Electrical Plant, Power Equipment, Lecture and Laboratory Equipment. The tuition is $60 a year, besides a laboratory fee of $5 per term.

A WESTINGHOUSE NIGHT.

The New Works at Brinton the Scene of Festivity and Dancing.

On Wednesday evening last, the city of Pittsburg gave a reception and banquet to the G. A. R. visitors who have been holding their annual encampment there. The new works of the Westinghouse Company at Brinton were chosen as the most desirable place as the gathering was a large one.

Special trains conveyed the guests direct to the works, and the 8,000 people present were conveyed to and from the city with perfect convenience to every one.

The extent of the plant was the marvel of all, few of whom had realized the extent of buildings 720 feet long. The interiors have all been painted white, and the 400 arc lamps, which had been connected for the occasion, furnished plenty of light. There were music and dancing for the merry and a sumptuous banquet for the hungry. The guests of honor were Gov. McKinley and ex-Gov. Alger.

It was a gala night in the history of Pittsburg's best society, which turned out in full force. The ladies of the Reception Committee included Mrs. George Westinghouse, Jr., Mrs. Herman Westinghouse, Mrs McKinley, wife of Gov. McKinley, Mrs. John A. Logan, Mrs. C. L. Magee, Mrs. R. A. Alger, Mrs. Lucius Fairchild, Mrs. C. C. Wiley, Mrs. Robert Pitcairn and Mrs. Scott Ward.

No manufacturing plant has ever had a housewarming of such magnificence, or one which will be so long and pleasantly remembered by so many people.

National Electric Light Association.

The Executive Committee of the National Electric Light Association held a meeting at the Hotel Brunswick, New York City, September 11, to determine the place for holding the next annual convention of that body.

The members in attendance were President M. J. Francisco, Secretary Geo. F. Porter and Messrs. Jas. I. Ayer, H. J. Decamp, H. J. Smith, C. O. Baker, Jr., and E. F. Peck.

The electrical press, which had been invited to attend, were represented by C. W. Price, *Electrical Review*; W. D. Weaver, *Electrical World*; Geo. M. Phelps, *Electrical Engineer*, and Geo. R. Metcalfe, ELECTRICITY.

Dinner was served for the members at 7 o'clock during which the location of the next convention city was informally discussed. Cleveland, Ohio, was finally selected for the meeting, which will be held February 19, 20 and 21, 1895.

Personal.

Mr. Morgan Brooks, president of the Electrical Engineering Company of Minneapolis, Minn., was in New York last week. Mr. Brooks spoke cheerfully of the prospects for improvement in the electrical business throughout the country.

Mr. William B. Roberts, formerly general manager of the Rockford (Ill.) Electric Manufacturing Company, is now with the Johnson Electric Service Company, 38 Clifford street, Detroit, Mich.

Legal Note.

The affidavit of Thomas A. Edison, which is attached to the bill asking the appointment of a receiver for the North American Phonograph Company, has just been filed. He alleges that the company became indebted to him $78,518.37, in addition to 220 bonds of $100 each, the interest on which had not been paid; that the company gave him a promissory note, and pledged the total stock of the Edison Phonograph Company which it possessed as collateral security; that the note has never been paid, and that he sold the stock at auction for $10,000, and that the remainder of the money has never been paid.

Canadian Notes.

Letters patent have been issued to the Packard Electric Company, capital $300,000, for the manufacture of an electric plant at Toronto. The incorporators are all Americans with the exception of Messrs. C. C. Page and F. Cavanagh, of Montreal, and A. Mackenzie, of Toronto.

Mr. Wm. McKenzie, president of the Toronto Street Railway Company, and Mr. Mann, of Montreal, have submitted a proposal to the Winnipeg City Council for the erection of extensive gas works on condition of certain concessions. It is said they are also considering the extension of their street car system to Armstrong Point, a residential suburb about two or three miles from the center of the city.

Stouffville, Ont., is to have an incandescent system of electric light.

It is said the City Council of Hamilton will be asked shortly to submit a by-law to the ratepayers asking a bonus of $125,000 in aid of the Hamilton Waterdown and Guelph Electric Railway. It is said the promoters of the road, among whom are J. T. Flatt, W. O. Sealy and W. P. Howland, of Toronto, have enough money subscribed to build the road, with the aid of the bonus asked, the estimated cost of which is in the neighborhood of $300,000.

There is an agitation on foot in Ottawa for a limited Sunday service. This is the first time the Sunday car question has been raised in Ottawa, and it is not unlikely it will lead to a lively fight.

It appears that the rumors as to the sale of the Metropolitan Street Railway to the Toronto Company are without foundation. Mr. J. C. Grace, secretary of the Toronto street railway, says he knows nothing of the matter.

W. H. Glassco, W. Southam, Richard Fuller, J. W. Hendrie, W.A. Wood, W.W. Osborne and John Patterson, of Hamilton, have applied for incorporation for the Cataract Power Company. The capital stock of the company is $100,000. The object of the company is to bring electrical power from Niagara Falls to Hamilton.

General News.

What is Going on in the Electrical World.

McKeesport, Pa.—The McKeesport and Wilmerding Electric Railway Company has purchased outright the Citizens' Railway.

Rochester, N. Y.—The Rochester Electric Railway has been leased to the Rochester Railway Company for a term of fifty years.

Elmira, N. Y.—Propositions are under discussion for the reorganization of the Improvement Company, which controls the electric light plant and street railways.

Alameda, Cal.—The Alameda, Oakland and Piedmont Electric Railroad Company was granted a franchise for their proposed road on an offer of 2 per cent. of the gross receipts.

Florence, Col.—At a special election called for that purpose a franchise was granted to the Arkansas Valley Electric Company to erect an electric light plant for this city.

Gettysburg, Pa.—The power house of the Gettysburg Electric Light Company was burned to the ground on the 10th inst. The loss to the company is estimated at $40,000.

Oswego, N. Y.—The commissioners of public works have prepared specifications on which bids will be solicited for electrically lighting this city's streets. All bids must be in before October 15.

Bordentown, N. J.—An ordinance authorizing the organization of an electric light company in this town was presented at the last meeting of council, read and referred to the law and ordinance committee.

Council Bluffs, Iowa.—The electric railway to Lake Manawa is so far assured that the promoters promise to have rails laid before November and to have the road fully equipped before the 1st of June next.

Boston, Mass.—The work of placing the overhead wires underground is proceeding rapidly and smoothly. Commissioner Murphy says that every wire in the section laid out will be underground by the end of the year.

St. Louis, Mo.—Electric ambulance cars have been tested here and proved satisfactory, greatly reducing the time required to remove patients to distant hospitals. The cars are switched off the street lines on to tracks laid to the hospitals.

Dayton, Ohio.—A committee report from the board of trade recommending the construction and operation of its own electric light plant by the city has been presented to the board of city affairs and referred to the committee on light.

Chagrin Falls, O.—The Chagrin Falls Electric Light Company has been granted a ten years' franchise by the council for lighting the town, and has commenced the work of putting in its plant. The company is required to turn on the lights by October 1.

New York. The directors of the Western Union Telegraph Company at a meeting on the 12th inst. declared the regular quarterly dividend of 1¼ per cent. The financial statement shows a surplus after charges and dividend of $365,000, against $381,154 in the same quarter of 1893.

Grand Rapids, Mich.—E. C. Paramore and Thomas F. Brady, Philadelphia electricians, have had a consultation with the board of trade and several local capitalists with a view to establishing a plant here for the manufacture of electrical machinery and all kinds of electrical appliances.

Somerville, N. J.—The board of commissioners has granted the right of way through the main street of this town to the New York and Philadelphia Traction Company. It is now thought the Traction Company will have no difficulty in getting a like privilege in the neighboring towns.

Willimantic, Conn.—The Willimantic Electric Light Company are enlarging and improving their plant. They are putting in a new Ball dynamo to run their street lamps and twelve new Ball street lamps. They also have a Westinghouse dynamo ordered, to be connected for use in case of accident to the dynamo now running.

Helena, Mont.—The consolidation of the Helena Electric and Rapid Transit railways has gone into effect. The two properties were placed in the hands of a committee of trustees, consisting of H. M. Parchen, C. K. Wells and T. A. Marlow, to manage affairs until the details of the operation of the consolidated company can be perfected.

Haddonfield, N. J.—The township committee has passed the ordinance granting to the West Jersey Traction Company the privilege of laying a double track road from the borough limits of Collingswood to the Haddonfield borough limits, on the turnpike, and also to erect poles and string wires. Work will be commenced immediately.

Indianapolis, Ind.—The Jenney Electric Company denies the statement that its removal to Springfield, O., was caused by an insufficiency of accommodation at the banks here, and asserts that the principal cause was the high rent it would have to pay for the ground needed. The company will employ 100 men when in operation at Springfield.

Philadelphia.—The Traction Company is arranging to take up its cable system, which is to give place to the trolley. The principal engineering difficulty in making the change is the work of taking up the conduits which were laid in solid cement and strongly constructed. A powerful machine is being built with claws strong enough to lift the conduit and its adherings.

Jamestown, N. Y.—The common council has accepted the bids of the following companies for the city's electric light plant: For the erection of the building, Mahoney & Jones, of Jamestown; the steam system, the Russell Engine Company, of Massilon, O.; alternating dynamo, the Westinghouse Company; three arc dynamos and complete pole service construction, the Standard Electric Company.

Reading, Pa.—The Pennsylvania Street Railway Association at their meeting here lately elected the following officers: President, John A. Rigg, Reading; first vice-president, Robert E Wright, Allentown; second vice president, G. A. Greenwood, Pittsburg; secretary, S.P. Light, Lebanon; treasurer, W. H. Lannius, York; executive committee: C. L. Magee, Pittsburg; J. J. Patterson, Lancaster; B. F. Myers, Harrisburg, with the president and secretary ex-officio.

Detroit, Mich.—The corporation of Charles F. Rich & Co., who filed a chattel mortgage on June 29, have reorganized under the name of the Charles F. Rich Company for the manufacture of gas and electric fixtures. Mr. Rich states that "the new corporation starts in without any indebtedness and with the determination that with reduced expenses and increasing business it will be of sufficient commercial importance to its old creditors to eventually make good any immediate losses."

Manchester, Ohio.—The proposed electric railroad between Manchester and West Union will be built and the work will begin within three weeks. The company has been incorporated as the Manchester and Northern Railway Company. It is now proposed to extend the road to this city, where it will connect with the Cincinnati, Portsmouth and Virginia Railroad, and Frank E. Holliday, of Ironton, the promoter of the line, has taken action in securing the right of way between West Union and here.

Peekskill, N. Y.—A company is being formed here to build and operate an electric trolley railroad through the principal streets of this village. The road will probably connect with Lake Mohegan, a favorite resort several miles out of town, and with the State Camp of Instruction. The directors are Charles E. Hammond, Dr. J. N. Tilden, T. D. Husted, J. W. Westbrook, Henry L. Armstrong, of Peekskill; A. E. Beach, E. B. Gallagher, G. D. Hiscox and B. J. Rogers, of New York. They have already purchased property for a power-house and car sheds.

Paterson, N. J.—The New Jersey Electric Railway Company has filed its certificate of incorporation in the Passaic county clerk's office. The stockholders are the same men that are interested in the system of railroads running between Paterson, Passaic, Rutherford, Carlstadt, Garfield, Hoboken and Jersey City, and known as the Morrisee system of electric railroads. The new company will construct a line over the Valley road, which skirts Garret Mountain, an extension of the Orange range, from Paterson to Orange, and eventually will build a road to Philadelphia.

Trenton, N. J.—Sealed proposals will be received at the office of the Adjutant-General at Trenton, until 12 o'clock on Tuesday, the 25th inst., for furnishing material and labor necessary to erect and complete electric wiring for the Jersey City Armory, including electric apparatus for lighting gas fixtures in drill shed only. Plans and specifications will be on file at the office of the architect and engineer, Charles Alling Gifford and William P. Field, in Room 435, Prudential Building, Newark. Proposals must be on blanks and enclosed in envelopes to be furnished to the contractor. The right is reserved to reject any and all bids.

Baltimore, Md.—At the breaking of ground for the Baltimore, Middle River and Sparrow's Point Electric Railway on the 4th inst., three nickel plated picks were used, and when they struck the sod a cheer went up from 500 throats, a brass band played "My Maryland," and there was great enthusiasm. A luncheon was subsequently served at which prayer was offered by Rev. J. Wynne Jones, who afterward made one of the best speeches of his life, in which he said he knew of nothing that has been a greater blessing to the working classes than the outlying electric roads. The directors of the new company are James Young, James Gilmor, Daniel Crook, Levin Morris, J. Theodore Oster, August Wehr, George R. Willis, Jacob W. Hook, J. J. Forrester, Theodore J. Gorsuch and Thomas B. Gatch.

Washington, D. C.—Some experiments are in progress under the direction of the Lighthouse Board to test a method of obtaining telephonic communication between the Government lightships lying off the Atlantic and Pacific coasts from two to twelve miles with the main land. Many experiments looking to this end have been made in the past, both by the United States and England, but all attempts heretofore have failed owing to the fact that the cable connecting the lightship with the main shore always fouls with the anchor chains of the lightship in the course of time, as a result of the shifting of the ship due to the action of wind and tide. A Western electrician has submitted to the Lighthouse Board a plan to overcome this difficulty and the board is now making an exper-

iment with a cable between Scotland Lightship and Sandy Hook. Rear-Admiral Greer has issued instructions to mariners not to anchor within 1,000 feet of the cable buoys during September and October.

Gilliland Telephone Company.

The Gilliland Telephone Company, of 186-188 Fifth avenue, Chicago, are now prepared to sell outright Telephones, Magneto Transmitters, Magneto Bells, Telephone Switchboards and Apparatus.

The Gilliland Telephone Company are incorporated and thoroughly organized for the further purpose of constructing Telephone Exchange plants, building private lines, or equipping hotels, factories, resident apartments or department stores with a complete telephone speaking tube system. The company's Telephone set consists of Magneto Call Bell, Desk and Backboard, Hand Receiver with Cord and Bi-Polar Magneto Transmitter, neatly and compactly put together in a style familiar to the public, and their aim is evidently to supply a telephone which will give satisfaction both electrically and mechanically. In principle of construction those features are embodied which experience in Telephone service demonstrate to be the most efficient and reliable. The Gilliland Telephone is at once simple in construction and reliable in operation; it requires no battery and is non-infringing; it can be applied to long or short distance lines, for "metallic" or ground circuit. Telephone experts who have made careful and thorough tests unhesitatingly pronounce this Telephone, if not unequalled, absolutely of the first class.

The Gilliland Company employ men of experience and ability for the purpose of Telephone Exchange construction and electrical work, and are prepared to furnish estimates promptly, or contract for electrical work at once. They solicit correspondence.

A New Trolley.

The accompanying illustration gives an excellent view of the Faulk trolley wheel and harp, which is being offered to street-railway people by the Central Electric Company, 173-175 Adams street, Chicago. W. R. Garton, in charge of their street-railway department, considers this a great improvement over other styles of wheels which use graphite or roller bearings. The Faulk trolley is constructed with cone bearings, so arranged that they adjust themselves automatically to the slight wear The wheel is at all times kept in a perfectly true position, so that while it is allowed to revolve with entire freedom it never rattles or wobbles. An important feature is the "dope" chamber inside the wheel. This carries sufficient lubricant for many miles of travel. No grease or oil is wasted by dripping or leaking. All removable parts are secured by steel cotter pins so that they cannot work loose. The Central Electric Company has some new literature in preparation describing improved railway devices; these circulars will be mailed to every one interested.

COMMERCIAL PARAGRAPHS.

The new catalogue of the Iona Manufacturing Company, 336 Congress street, Boston, supersedes all previous lists sent out by the company, and customers are requested to send for the new issue as the price lists have been changed to correspond with the net prices of goods. The catalogue has handsome illustrations of the company's specialties, including switches, flush switch plates, cutouts, street fixtures, time registers and gongs.

A pamphlet just issued by the Johnson Electric Service Company, of Boston, Milwaukee, Minneapolis, Detroit and Pittsburg, contains a description of the Johnson system of temperature regulation, a number of illustrations of the apparatus and several pages giving names of public buildings, hospitals, asylums, churches, hotels, theatres, offices and private dwellings in which the system is in use. The Johnson system of heat regulation has grown in favor in every locality in which it has been observed in practical operation, and the long list of installations recorded in the pamphlet attests its popularity. It can be applied to any system of heating.

The Wirt Electrical Indicators were designed to avoid as far as possible the defects of other apparatus of the kind used in incandescent lighting, and are "simple, sensitive, accurate, constant and durable." The cases of the instruments are entirely of metal, as are all other parts, except where insulating material is used. The moving system is extremely light and pivoted with strong, well-tempered, perfectly polished pivots with ruby jewels. The instrument can be read at a distance, and the slightest variation is quickly noticed with the help of the movable index or sight, which is provided with all volt and with constant current ampere indicators. The consumption of energy is so small as to permit the instrument to be left in circuit continuously. The indicators are manufactured by Charles Wirt, 56 Fifth ave., Chicago.

The Dale Manufacturing Company, 22 Cortlandt street, New York, have issued a neat and well-filled catalogue, profusely illustrated with cuts of their electric and combination fixtures and materials used in interior wiring. Operators of electric lighting and power plants, electrical contractors and wiremen should have a copy always at hand.

The Mather Electric Company of Manchester, Conn., report as a sign of the revival in the electrical business the closing in three consecutive days last week of contracts for more than 1,500 horse power of their standard apparatus, consisting of direct connected and belted generators and their Manchester type slow speed motors. This, with the other work the Mather Company now have on hand, will compel them to at once increase their working force, although part of their works is now being operated at night. They also report through their New York contractors, Messrs. H. B. Coho & Co., 203 Broadway, the sale of all the electrical machinery for the new Odd Fellows Hall at Philadelphia, consisting of one 30 K.W., one 50 K. W., and one 80 K. W. direct connected generators and five Manchester type slow speed motors from 1 to 40 H.P.; also the sale to Henry R. Worthington Company for their Brooklyn Hydraulic Works, one 600 light dynamo, one 50 H. P. 220 volt generator and one 10 H. P. motor.

INCORPORATIONS.

The Block Lighting and Power Company No. 1, New York City—to manufacture electricity for producing light, heat and power. Capital stock, $50,000. Promoters: Rob't Stafford, A. M. Palmer, Edward Lauterbach, New York City.

The Middletown Electric Light and Power Company, Middletown, Ohio—to generate and supply electricity for light, heat and power. Capital stock, $4,000. Promoters: E. H. McKnight, Joseph Schuer, W. J. Peters, George S. Long, Sam J. Miller, Jacob Henne.

The Chicago, Oak Park and Harlem Street Railway Company, Chicago, Ill.—to construct, own and operate street railways in Cook County, and furnish electric light, heat and power. Capital stock, $50,000. Promoters: Jno. C. Schumacher, Jr., Jno. Gnaedinger, Gustav A. Pudewa, Frank Troost, Henry D. Schumacher.

The Momence Electric Ball Storage Battery Company, Momence, Ill.—to manufacture storage batteries and other electric appliances. Capital stock, $15,000. Promoters: Chas. A. Smyth, Lincoln Walker, Frank E. Lane.

The Coalport-Irvona Light, Heat and Power Company, Coalport, Pa.—to supply light, heat and power by electricity in Coalport. Capital stock, $10,000. Promoters: R. A. Holden, A. P. MacLeod, Coalport; J. E. McDowell, Irvona, Pa.

Brown's Electrical Supply Company, Minneapolis, Minn.—to manufacture all kinds of electrical and mechanical appliances, attachments and machines, etc. Capital stock, $250,000. Promoters: Chas. D. Brown, Wm. H. Brown, P. W. McAllister, Minneapolis.

The Phœnix Electric Light Company, McKees Rocks, Pa. Capital stock, $5,000. Directors: John E. Heinzman, W. S. McLain, Jr., Pittsburg; Edwin C. Johnson, Allegheny City.

The Lancaster and Susquehanna Railway Company—to build an electric line from Lancaster to Columbia, Pa. Capital stock, $100,000. Directors: John S. Graybill, president; William B. Given, Sam Matt. Friday, Samuel O. Frantz, Horace L. Haldeman, J. W. Bausman and John Hertzler.

The Southwestern Suburban Rapid Transit Company, Chicago, Ill.—to build, equip and operate a horse or dummy railroad with motive power furnished by horse, dummy or electricity, to build, maintain and operate electric plants for furnishing heat, light and power. Capital stock, $1,000,000. Promoters: Arechan H. Minassian, Newton Wilcoxon, Frank M. Sherman.

The Northern Electric Passenger Railway Company—to build and operate an electric railway from a point on the Limekiln Pike, near Edge Hill Station, Montgomery Co., Pa., to Philadelphia, including a number of streets within that city. Capital stock, $100,000. Incorporators: A. C. Milliken, Pottsville; Charles H. Davis, S. S. Evans, G. L. Martin, N. A. Waldron, Philadelphia, and W. B. Perry, Langhorne.

The Reading and Pottstown Electric Railway Company, capital stock, $100,000, was chartered at Harrisburg on the 12th inst.

The Portchester, Rye and Mamaroneck Electric Railway Company—to construct a street railroad about nine miles long in the village of Portchester and in the towns of Rye, Harrison and Mamaroneck, Westchester County, N. Y. Capital stock, $150,000. Directors: John W. Lounsbury, William Ryan, William L. Ward, Hanford M. Henderson John F. Mills and Josiah N. Wilcox, of Portchester; Bernard Bruch, of Rye; John A. Tremper, T. Floyd Woodworth and Charles D. Haines, of Kinderhook, and Wilson Miller, of Valatie, N. Y.

Monticello Light, Heat and Power Company of Monticello, Sullivan County, N. Y. Capital stock, $20,000. Directors: Frederick B. Hulse, of Thomsonville, N. Y., Medad E. Stone, of New Brighton, N. Y.; and Hiram R. Hulse, of New York City.

The Key West Light and Power Company, Key West Fla., have published articles of incorporation and will apply to the Governor of the State for a charter. They will construct and maintain a street railroad on the island of Key West to be operated by electric power, and will use the electric power for lighting and other purposes. Capital stock, $125,000. Directors: John Jay Philbrick, George W. Allen and Joseph C. Whalton, Jr., of Key West, Fla., and Lycurgus Laflin and Albert S. Laflin, of Chicago, Ill.

ELECTRICAL PATENT RECORD.

Letters Patent Issued September 11, 1894.

ELECTRIC RAILROADS AND APPLIANCES.

525,690. Electric-Railway System. Charles S. Bradley, Avon, N.Y. Filed Jan. 2, 1894.

525,782. Combined Brake and Electric Switch for Street-Railway Cars. George Brown, Long Island City, N. Y. Filed Jan. 20, 1894.

525,789. Trolley-Pole Connection. Maurice R. Mahon and John M. Crane, Newark, N. J. Filed Nov. 10, 1893.

525,864. Electric Railway. Herbert E. Rider, New York, N. Y., assignor to Adolph Falck, same place. Filed Feb. 26, 1894.

525,886. Trolley for Electric Railroads. Edward Dawson, Terre Haute, Ind. Filed Dec. 26, 1893.

525,945. Conduit System for Electric Railways. William G. Creighton, Chicago, Ill. Filed Feb. 28, 1894.

ELECTRIC LIGHTS AND APPLIANCES.

525,735. Electric-Arc Lamp. Stewart L. Campbell, Kalamazoo, Mich., assignor of one-half to Henry W. Rood, same place. Filed Jan. 23, 1894.

525,743. Electric Arc Lamp. Alexander B. Roney, Chicago, Ill., assignor to John E. Jacobs, same place. Filed March 7, 1894.

525,888. Manufacture of Carbons for Electric Lamps. Thomas A. Edison, Menlo Park, N. J., assignor to the Edison Electric Light Company, New York, N. Y. Filed March 20, 1880.

525,909. Incandescent Lamp Stand and Reflector. George F. Klemm, Philadelphia, Pa. Filed June 9, 1894.

525,929. Spark Shield or Protector for Electric-Arc Lamps. William M. Tompkins, Philadelphia, Pa., assignor of one-half to Albert H. Manwaren, same place. Filed June 22, 1893.

525,943. Electric Arc Lamp. Harold E. Bradley, New Bedford, Mass. Filed Feb 28, 1894.

MOTORS, DYNAMOS, ETC.

525,689. Electric Transformer. Charles S. Bradley, Avon, N. Y. Filed Aug. 22, 1891.

525,697. Winding for Drum Armatures in Dynamo Machines. Rudolf Eickemeyer, Yonkers, N. Y. Filed March 9, 1892.

525,698. Armature for Dynamo-Electric Machines. Rudolf Eickemeyer, Yonkers, N. Y. Filed April 3, 1894.

525,769. System of Electrical Distribution. James F. McElroy, Lansing, Mich. Filed Oct. 5, 1887.

525,836. Self-Adjusting Brush for Dynamo Electric Machines. William L. Bliss, Brooklyn, N. Y. Filed April 13, 1894.

525,993. Means for Equalizing Electromotive Force of Dynamos. Morris Moskowitz, Newark, N. J., assignor, by direct and mesne assignments, to the National Electric Car Lighting Company. Filed June 15, 1894.

526,016. Electric Motor. John S. Losch, Summit Station, Pa. Filed March 6, 1894.

TELEPHONE AND TELEGRAPH APPARATUS.

525,702. Telephone-Call System. Ezra T. Gilliland, Pelham Manor, N. Y., assignor to the American Bell Telephone Company, Boston, Mass. Filed Nov. 27, 1893.

525,703. Telephone Call System. Ezra T. Gilliland, Pelham Manor, N. Y., assignor to the American Bell Telephone Company, Boston, Mass. Filed Jan. 11, 1894.

MISCELLANEOUS.

525,704. Electric Clock. Fred L. Gregory, Chicago, Ill Filed Jan. 30, 1894.

525,708. Bus-Bar Insulating Support. Albert D. Herrick, Schenectady, N. Y., assignor to the General Electric Company of New York. Filed April 11, 1894.

525,730. Electric Fan. Charles Wachtel, Newark, N. J. Filed Jan. 17, 1893. Renewed Feb. 23, 1894.

525,732. Electrolytic Apparatus. Emile Andreoli, London, Eng. Filed Aug. 4, 1893.

525,779. Synchronizing Mechanism for Electric Clocks. Edgar Ayres, Sydney, New South Wales. Filed Oct. 7, 1893.

525,800. Manufacture of Wire Strips or the Like by Electrodeposition Richard D. Sanders, Eastbourne, Eng. Filed Aug. 3, 1892.

525,828. Electrical Igniter for Gas or Hydrocarbon Engines. Paul A. N. Winand, Philadelphia, Pa., assignor to Mess, Schleicher, Schumm & Co., same place. Filed July 26, 1893.

525,840. Lightning-Arrester. Archibald L. Courtright, Keokuk, Iowa. Filed Feb. 1, 1894.

525,866. Electrical Signaling Apparatus for Railways. Paul Schwenke, Zerbst, Germany. Filed April 8, 1892.

525,874. Electric Annunciator. Henry C. Thomson, Boston, Mass., assignor to the Electric Gas Lighting Company of Maine. Filed July 2, 1894.

525,891 Fastener for Electric Wires. Harry C. Fricke, Pittsburg, Pa. Filed June 14, 1894.

525,894. Recording-Voltmeter. Frederick D'A. Goold, Schenectady, assignor to the Edison General Electric Company, New York, N. Y. Filed April 16, 1892.

525,936. Electric Switch. George Baehr, Jersey City, N.J., assignor to Samuel O'Connor, Brooklyn, N. Y. Filed Jan. 9, 1894.

525,992. System of Lighting and Heatin Cars by Electricity. Morris Moskowitz, Newark, N. J., assignor, by direct and mesne assignments, to the National Electric Car Lighting Company. Filed March 31, 1894.

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EDITORIAL NOTES.

Street Car Brakes. The opposition which was at first offered to the introduction of trolley cars into a number of large cities, and which was chiefly based upon the alleged "deadly" quality of the trolley, has been wonderfully modified by subsequent experience with this now very general motive power for street cars. ELECTRICITY contended from the start that the accidents which provoked the opposition to electric railways were almost without exception due to the speed and lack of brake power of the cars, for which the motive power was in no way responsible, and this view of the subject is now generally accepted.

The importance of the brake on electric cars, or any others which travel at the rate of speed demanded by the public to day, is not secondary to that of any other mechanism on the car in its relation to safety of pedestrians, yet it must be admitted that this feature of the car equipment has failed utterly to keep pace with the improvements which have been made in the driving mechanism. For the past two or three years the demand for safety appliances has been met by the introduction of fenders, nets, guard rails and other modifications of the cowcatcher, which, if less deadly than the car wheels, are nevertheless worthy of being carefully avoided, and as the most efficient of these devices can only mitigate the consequences of a collision they are obviously as a cure of much less value than some means of prevention.

The subject is recalled by the interesting paper by Mr. Sperry, which we print in part this week. on the "Electric Brake in Practice," and aside from the unique method of braking devised by him, the paper contains a number of valuable suggestions on the subject of brakes in general which can be profitably studied by ever one interested in the subject of electric traction.

The demand for rapid transit in cities has made a speed far in excess of the car horse a necessity and the question of safety of foot passengers is the only limiting condition in determining the speed allowable. It is apparent also that the danger to pedestrians does not depend directly upon the car speed, but is in reality proportional to the time and distance within which a car may be brought from full speed to full rest, or in other words, it depends almost entirely on the efficiency of the brake. The ordinary hand brake used on heavy electric cars is by no means a satisfactory device even for the usual speed limit of eight miles an hour, and considered as an emergency brake it is entirely inadequate. Its defects, many of which are pointed out by Mr. Sperry, are very well understood by railway men, but the expense of any kind of automatic brake has we believe been the main reason for retaining the same device for electric cars that was used on the slower and much lighter horse cars.

It would be well, however, to consider the cost of accidents in connection with the subject of brakes before the actual expense of these safeguards is determined. Of the number of accidents which have occurred on the large railways in thickly settled districts, probably seventy-five per cent. might have been averted by the use of powerful emergency brakes. so that a very large proportion of the damages collected for accidents might properly be charged against the brake. In this aspect of the case it is more than probable that a considerable extra outlay for brake apparatus would result in material ultimate saving to the railway company. For roads on which steep grades are encountered, something more than the mechanical hand brake is absolutely essential, as the least derangement of this apparatus imperils not only pedestrians crossing the tracks. but all the passengers in the car as well. In the case of an electric car the alternative of reversing the motors is always at hand, but this is by no means a sure remedy as the violence of the shock is liable to strip the gearing or burn out the machines. Moreover, with some equipments the time required to manipulate extra switches will make this method unavailable.

The electric railway offers exceptional facilities for emergency brakes, as will be seen from Mr. Sperry's paper, and with this class of brakes the retarding force is properly applied, contrary to the action of the hand brake. To stop a car in the minimum time and with the least jar, the greatest retarding force should be applied at first when the force of inertia is the greatest, and may be then reduced as the momentum of the car decreases. Another important point in the system described by Mr. Sperry is that the momentum of the car is utilized to stop it, thus saving any drain on the station current, and making the device equally effective when the trolley connection is broken.

An emergency brake will before long be regarded as an essential part of electric railway equipments, and in addition to the usual hand brake it will provide every reasonable safeguard that can be demanded.

It would be well, therefore, instead of defeating the ends of rapid transit by fixing a limit to the speed of street railway cars, to legislate for the safety of foot passengers by requiring brakes which will bring a car to rest from full speed within a specified distance.

* * *

A Far-Reaching Decision. The legal department has declared that the G. E. Co. had little at stake in the feeder patent case recently decided against them. The patent if sustained would have been the most valuable in their list. They have spent on it up to date over $500,000. But of course there was "little at stake." A dozen blackmailing suits based on the feeder patent are killed before trial by Judge Acheson's decision, and yet the lawyers cannot see any reason to mourn. Why should they? There is a fund of $800,000 for them to spend this year, which naturally takes precedence of every other obligation of the company, even interest on the bonds.

As a matter of fact the loss of the feeder and main patent is the severest kind of a blow to the hopes of the company for continued existence.

It takes away almost the only remaining link tying the Edison licensees to the parent organization, and will precipitate the test case for damages and recovery of royalty which these licensees are believed to have fully prepared.

More than this, Judge Acheson's opinion, if it is held to be good law, will invalidate nine-tenths of the patents owned by the G. E. Co., because they are not *inventions*, but only improvements, or expedients for carrying out or amplifying discoveries already made known.

The decision is of far-reaching importance to every electrical manufacturing company—of vastly more consequence than the incandescent lamp decision or any other previous decision.

No one knows this better than the gentlemen at 44 Broad street, who were loudly proclaiming, when the preliminary injunction was granted by Judge Green that the patent would cover fully not only low-tension distribution, but alternating and railway work as well.

* * *

An effort is being made in Buffalo to arrange or a great electric carnival in that city at the time of the formal opening of the transmission line from the falls. This is a good idea, and Mr. Huntley can supply all the current needed.

A Bull Point. Among the many bull tips given out for publication by Mr. Coffin and his associates, chiefly accounts of large contracts taken by the G. E. Company and shipments of great magnitude, we have failed to find any mention of a good-sized shipment which recently went from the company's factories to Denver. It was not twenty-five car loads, but after all it deserves special mention.

There may be some secret reason why the company wished to conceal the facts in regard to this shipment, but Electricity believes in giving wide publicity to the progress being made by this remarkable company, even to the smaller details.

The transaction which has so far escaped public notice was the shipment of forty armatures to the Denver Tramway Company. They were not sold, but were presented by the G. E. Co. to the Tramway Company, to take the place of part of those which have burned out during the past year in the street car service of the latter company. The motors were the celebrated G. E. 800s, and the G. E. Co. were forced to make the substitution or stand a suit for damages.

* * *

The Stopper Lamp. Careful students of the incandescent lamp situation, men who want to know what there will or will not be in the lamp business after the Edison patent has expired, will make a serious mistake if they fail to take the Westinghouse stopper lamp into consideration. We have been keeping close watch of some of these lamps for several months, and can assure the public that they are successful lamps. Several large users have expressed their opinion to us that they are at least equal to any lamp on the market, and a leading central station man in central New York states that they are the best lamp ever used in his station. These lamps were placed on the market too soon, before the method of manufacture was perfected, and some lots gave trouble. This led to the opinion that the idea of a stopper lamp was an impractical one. We are convinced that this is not truth and that the stopper lamp is an important factor in the situation, regardless of the outcome of the litigation over the life of the Edison lamp patent.

Whatever the result of that litigation, there seems no reason to doubt that the Westinghouse Company will be the pacemakers in the lamp business and that they will name the price at which others must sell. Those who contemplate entering the field for the first time within the next few months should look over the possibilities for profit with great care, and our friends now in the business should not relax in the slightest degree their efforts to make as good a lamp as ever at less cost than at present.

The stopper lamp has come to stay, and we will yet see that "To Let" sign on the Harrison factory.

* * *

The G. E. Company recently sold in the town of Waverley, Ohio, a 1,000 light alternator, with 800 lamps and the necessary transformers, for less than $1,450. Is there any margin in this for dividends?

And now the officers of the General Electric Company say that the decision of the United States Circuit Court of Appeals in the feeder and main case is of no consequence whatever to them, and will have no effect at all on their business. To the ordinary man it would seem a little strange that the General Electric Company should have spent so much good time and money on a lawsuit the result of which did not in any way concern them, but their case is not without a parallel in history. A very brave man once climbed over a fence to make war upon a bull who up to that time had been minding his own business. Before the war was fairly started the bull tossed the man back to where he came from. In this return journey the man was very much damaged and somewhat stunned, but as his senses gradually returned he drew himself together, scraped the mud from his torn clothing, spit out a few broken teeth, wiped the blood from his noble brow, and holding his hands on the two spots that ached the hardest, he said with withering scorn: "That bull is no better off than he was before!"

* * *

A recent circular letter of the G. E. Company announces that Capt. Eugene Griffen is in charge of the entire selling force of the company, and that in his absence Mr. S. D. Greene will have full charge of the commercial department. Meantime the responsible head of the company, if there is any head, is Mr. Joseph P. Ord. Mr. Ord was not elected president, as we predicted he would be, but he has everything but the title of that office.

* * *

Those who are silly enough to pay any attention to the comments and opinions in the financial department of *Town Topics* are entitled to the information that this department in our nasty contemporary is edited by Mr. Harry Weil, who holds regular conferences with Mr. C. A. Coffin to decide upon what the comments on G. E. shall be. The views of such unprejudiced authorities have, of course, great value!

* * *

When the organization committee, which we suppose will soon be appointed by the G. E. Board, comes to consider the matter of making good the impairment of the capital, officially acknowledged to be over $12,000,000 some months ago, they will also be confronted with a further decrease in the assets of over $8,000,000, which was said to be represented by patents in the last annual report. The entire list of patents on the books would not bring $8,000 if sold in the open market. The feeder and main patent was valued on the books at $4,000,000, the lamp patent and the three-wire patent making up the balance. The former will be worthless in less than sixty days, and we don't know of any one who cares much about the three-wire system except those who have it installed.

* * *

Our esteemed contemporary, the *Western Electrician*, pats itself on the back by reprinting comments on its "enterprise" taken from the World's Fair book of Prof. Barrett and Dr. Hornsby. Inasmuch as these comments were originally written in the sanctum of our contemporary, and furnished to Author and Professor Barrett and Man Friday and Doctor Hornsby, they should be perfectly satisfactory to that journal. It is said in Chicago that the wondrous fellow feeling exhibited between Barrett and Hornsby and the young men who edit our esteemed Western contemporary is due to the fact that they all received their technical education in the same school—the College of Esgiebtnicht in the State of Wiessnichtwo.

* * *

ONE HUNDRED DOLLARS has been invested in the incorporation of a company to build an electric road from Pittsburg to Chicago.

* * *

DR. WELLINGTON ADAMS said to a St. Louis reporter, after Judge Hallett's decision, "I am paralyzed!" We think the Doctor exaggerated; we do not think he is paralyzed, either in body or in mind. He will continue to hustle in his own peculiar fashion, and will have a new scheme before the month is out. That his mind is not affected any worse than it always has been is proved indeed by his other remarks in the same interview: "The decision will not affect the St. Louis and Chicago Electric road, except that it will not be able to keep out competition as it otherwise would. Anyone may build a parallel road and hurt our road in this way." Paralyzed? No, indeed; not while there is treasury stock of the great Chicago and St. Louis Air Line yet unsold. But who would be so ungracious as to attempt to parallel any scheme of this irrepressible inventor? It can't be done.

Patent Litigation.

The Adams Patents Rejected in the United States Circuit Court.

The patents of Dr. Adams, which have been claimed by his supporters to cover the fundamental principles of electric traction, have just sustained an adverse decision in the case of the Adams Electric Railway Company vs. The Lindell Railway Company, of St. Louis.

The opinion, which was written by Judge Hallett, concludes: "I do not find anything in the patent which can be recognized as an invention, and, therefore, I am constrained to dismiss the bill with costs."

The case has been in litigation for the last four years and is based on the claims of the complainant's patent, issued June 24, 1884, which are as follows:

"1. The combination, with the axle which carries the driven wheels, the axle boxes or bearings, and a frame secured to or formed in one with said boxes or bearings, of an electric motor whose armature is mounted to revolve on said axle, and whose field is attached to and carried by said frame, substantially as and for the purposes hereinbefore set forth.

"2. The combination, with the driven wheels, their axle and axle boxes or bearings, and a field-supporting frame secured to or formed in one with said boxes or bearings, of an electric motor whose armature and field are carried by said axle and frame, respectively, and intermediate motion-transmitting gearing, also carried by said frame, and meshing on the one hand with a gear on the driven wheels and on the other with a gear on the armature-hub.

"3. The driven wheels, their axle and axle boxes or bearings, and the supporting-frame secured to or formed in one with said boxes or bearings, in combination with the armature mounted to revolve on said axle, and the field-magnets, commutator-brushes, and intermediate motion-transmitting gearing mounted in and carried by said supporting-frame, under the arrangement and for operation as hereinbefore set forth."

The gist of the opinion is contained in the concluding paragraphs which state: "Whatever power may be used to drive four-wheel vehicles, a flexible connection between the axles, so that each may rise and fall independently of the other, has long been in common use. If, therefore, we accept the field-supporting frame of complainant's patent as a short truck frame adapted to oscillate upon one axle so as to yield to the torque motion of the motor, we have nothing more than a change in connection with the other axle and an adaptation of an old device to new conditions. This is the point discussed at length at the hearing, and indeed the only point in the case worthy of serious consideration.

"Upon full examination of the record and the very able arguments of counsel. I am not convinced of the merits of the patent."

American Institute of Electrical Engineers.

At the meeting of Council, held September 19, the following associate members were elected:

George O. Baker, New York City; Ernest Julius Berg, Schenectady, N. Y.; Charles M. Blanchard, Germantown, Pa.; Willard E. Boileau, Columbus, Ga.; E. D. H. Brady, Waterbury, Conn.; Edward D. Brown, Brooklyn, N. Y.; Harvey Stuart Chase, New York City; George Bonne Compagnie, Antwerp, Belgium; J. W. Crews, Norfolk, Va.; Harry Cooke Cushing, Jr., Boston, Mass.; Frederic W. Darlington, Philadelphia, Pa.; Darragh DeLancey, Rochester, N. Y.; William A. Drysdoll, Overbrook, Pa.; Francis Marion Dyer, New York City; Morton Edward Eden, Pittsburg, Pa.; Wm. C. L. Eglin, Philadelphia, Pa.; Charles L. Eidlitz, New York City; Edward B. Ellicott, Chicago, Ill.; F. William Erickson, Pittsburg, Pa.; Frank G. Fuller, Meriden, Conn.; Louis Jay Gerson, Philadelphia, Pa.; Elwood Aristides Grissinger, Mechanicsburg, Pa.; Herman Hollerith, Washington, D. C.; G. Wilbur Hubley, Louisville, Ky.; Arthur L. Hunt, Utica, N. Y.; Carl E. Kammeyer, Chicago, Ill.; Fred A. La Roche, Philadelphia, Pa.; Chester Wolcott Lyman, Herkimer, N. Y.; James Lyman, Middlefield, Conn.; Frank P. Medina, San Francisco, Cal.; L. E. Myers, Chicago, Ill.; Henry Noel Potter, Pittsburg, Pa.; Chas. W. Price, Brooklyn, N.Y.; Harry D. Reed, Newark, N. J.; Robert E. Richardson, Chicago, Ill.; Wm. H. Roberts, Cincinnati, O.; John E. Roller, Brooklyn, N. Y.; Arthur John Rowland, Philadelphia, Pa.; W. J. Shields, Burlington, Vt.; Arthur J. Slade, New York City; Frank E. Smith, San Francisco, Cal.; J. Franklin Stevens, Philadelphia, Pa.; Frank M. Tait, Catasauqua, Pa.; Thomas W. Varley, Passaic, N. J.

In accordance with the preference expressed by a plurality of members in Chicago and vicinity, the Council appointed Mr. Bion J. Arnold local honorary secretary for that city to succeed Mr. Edward Caldwell, resigned on account of his removal to New York.

Electric Cooking.

Cooking by electricity is making great progress in England. The public interest has been aroused by exhibitions held in various parts of the country. Public banquets, at which the viands disposed of are cooked by electricity are nothing uncommon. The business at present is monopolized by two or three London firms, and these work together with the City of London Electric Lighting Company in seeking customers. There has now been opened in Queen Victoria street, London, by one Jesse Percival, the first electric cooking restaurant in Europe. The various departments are both lighted and heated by electricity, and the premises, which accommodate sixty persons, are much patronized by city men.

The Motor Was Libelled.

(From the Little Rock Press.)

The report in circulation this morning that an electric motor had become unmanageable and ran away, injuring three ladies, was false.

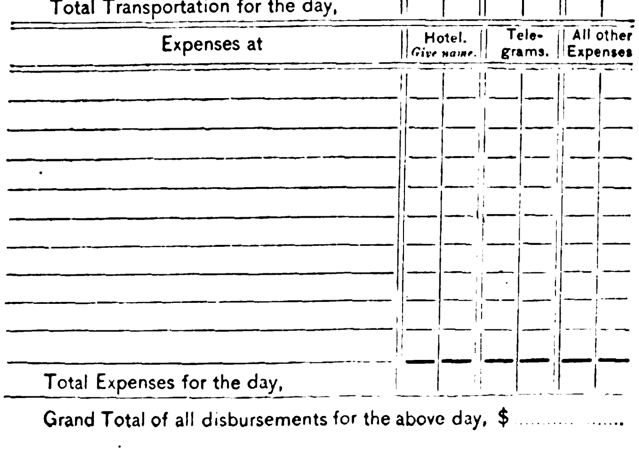
NO MORE ENTERTAINING.

We present below a photographic reproduction of two pages from the recently issued expense account book for the use of the G. E. officers and employes. Every man in the company from the president down will hereafter be restricted in his expenditures, as indicated in the blank form.

There will be no more entertaining, no more suppers, no more cocktails at the company's expense. We suppose an occasional five cent cigar will pass, or a bunch of cigarettes.

The books have been supplied in large numbers to the local offices, where they are suffering the same base uses to which Mr. Ord's earlier work, the "Book of Instructions," was put by disrespectful employes.

The leaks at the spigot are nearly stopped. The bunghole is getting larger every day.



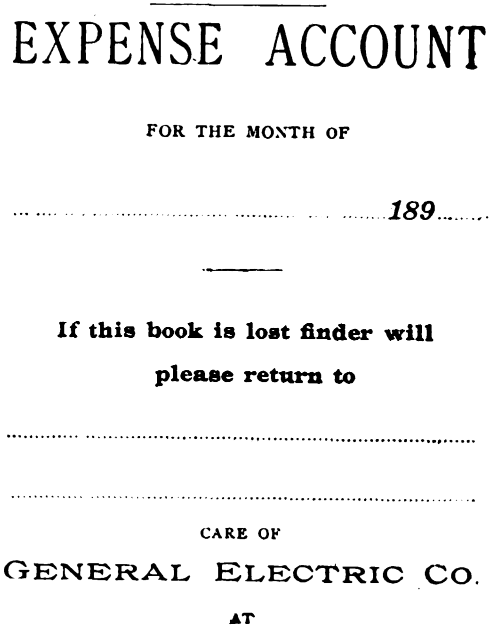
For the........... Day of .... 189.......

Object of Trip,..

Transportation		R. R. Fare.	Sleeping Berth or Chair Car	St. Cars, Baggage, or Bus.
From	To		State which	
Total Transportation for the day,				

Expenses at	Hotel. Give name.	Telegrams.	All other Expenses
Total Expenses for the day,			

Grand Total of all disbursements for the above day, $ ....



EXPENSE ACCOUNT

FOR THE MONTH OF

.... 189.......

If this book is lost finder will please return to

....

....

CARE OF

GENERAL ELECTRIC CO.

AT

The Potential and Current Curves of Different Types of Alternators, and Their Influence on the Candle-Power of Alternate-Current Arcs.*

BY G. RÖSSLER AND W. WEDDING.

(Concluded.)

The lamp, as above described, was run with 10 amperes, and carried close above the arc the universally-employed white enamelled reflector, thus lighting only the space below it. The lamp was carefully regulated for each machine, and it was found possible, after some practice, to regulate with such accuracy that the maximum deviations were not more than 0.3 volt. That pressure was chosen for the measurements which kept the lamp in the most stable condition, the observations being always made at the same pressure, which kept very constant, and which varied on different days and for different machines from 28·8—31·1 volts. In order to attain an even consumption of the carbon during each set of observations each was begun after running the lamp for two hours, and the carbons used were cored carbons of the Siemens A type, 10 mm. thick.

The photometric arrangements were those usual in the Berlin Electro-technical Laboratory. As comparison, a glow-lamp was used on each side, run at high efficiency to make it as white as possible, and whose pressure was controlled by a Weston voltmeter. After each set of observations the candle-power of each lamp was tested by comparison with a Hefner lamp. In order to determine as accurately as possible the distribution of illumination in two adjacent quadrants lying under the horizontal plane, about 17 observations for each quadrant were taken, the angles being taken close together at about 45° and further apart at the horizontal and vertical planes, and 6—12 observations were made on each photometer for each angle.

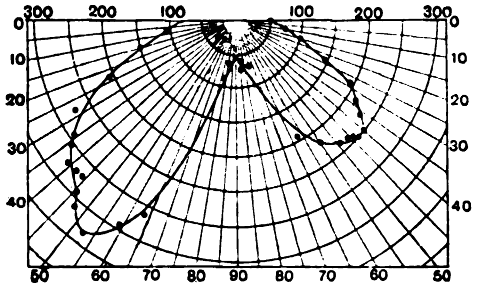


FIG. 12.

In circuit with the arc lamp was an inductionless resistance, on which, by means of an electrometer, the pressure for the determination of the current curve was read, a regulating resistance for the lamp, an ammeter by Schuckert, a Thomson balance to standardize it by, a Helios wattmeter and a Cardew voltmeter. This last was on the terminals of the lamp, and in parallel with it the pressure coil of the wattmeter, also a connection for determination by the electrometer of the pressure curve (see Fig. 7). The standardization of the voltmeter was done by the electrometer, of the ammeter by the Thomson balance, and of the wattmeter by both; and as ultimate standard the well-known compensation apparatus of the Reichsanstalt. It was found that the Schuckert ammeter readings had to be multiplied by 1·311 for the Ganz machine, with 40 volts; with the Wechsler machine the factor fell to 1·018, and for the Siemens to 1·018.

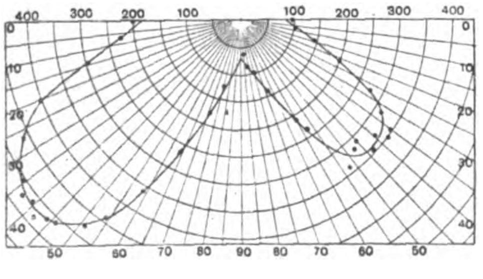


FIG. 13.

There are nine sets of observations for the Ganz machine. Table IV gives the complete values for the various angles of one of these sets. The figures are the mean of from 6—10 observations.

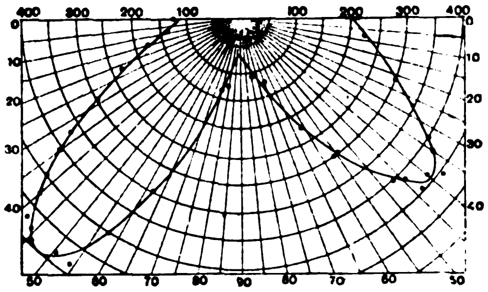


FIG. 14.

In the first three columns we find the electric quantities, allowing for the energy consumed in the instruments. The next four columns give us the photometrical measurements for each angle, which were made in pairs in the opposite quadrants. The last column shows the mean spherical intensity under the horizontal reduced to one watt between the lamp terminals as found by the usual geometrical construction. The variations occurring in the measurements of the candle-power between 30°—60° are due partly to the reflector and partly to uneven consumption of the carbons.

The first three of the following tables relate to the curves given in Figs. 8, 9, and 10 of the preceding part of this paper.

TABLE I.—*Ganz Machine.*

Position of contact. Degrees.	Pressure. Volts.	Current. Amps.	Power. Watts.	Remark.
65	- 23·3	- 3·6	+ 85	Between 55°—250° the Maximum. Pressure is 72·3 Volts.
60	- 36·7	- 6·9	+ 254	
55	- 66·0	- 15·2	+ 1004	
50	- 61·0	- 23·9	+ 1442	
45	- 44·0	- 18·0	+ 790	
40	- 36·3	- 11·0	+ 397	
35	- 26·0	- 6·6	+ 173	
30	- 16·9	- 4·3	+ 72	
25	- 12·4	- 2·9	+ 35	
20	- 9·3	- 1·9	+ 17	
15	- 7·2	- 1·2	+ 8	
10	- 3·5	- 1·0	+ 4	
5	+ 0·9	- 0·3	- 0·3	
360	+ 6·2	0·0	0·0	
355	+ 10·3	+ 0·3	+ 4	
350	+ 13·9	+ 0·9	+ 13	
345	+ 17·1	+ 2·2	+ 37	
340	+ 20·8	—	—	
335	+ 25·3	+ 3·8	+ 95	
330	+ 36·3	+ 6·1	+ 221	
55	—	- 15·0	—	Final repetition of Current Measurement.
50	—	- 23·9	—	

TABLE II.—*Wechsler Machine.*

Position of contact. Degrees.	Pressure Volts.	Current. Amps.	Power. Watts.
180	+ 36·5	+ 12·8	+ 467
185	+ 32·1	+ 10·6	+ 341
190	+ 23·8	+ 8·3	+ [illegible]
195	+ 13·1	+ 5·7	+ 74
200	+ 6·2	+ 3·3	+ 21
205	- 6·4	0	0
210	- 10·3	- 3·2	+ 45
215	- 16·1	- 5·0	+ 81
220	- 19·7	- 6·8	+ 133
225	- 22·5	- 8·1	+ 182
230	- 29·7	- 9·4	+ 274
235	- 35·3	- 10·3	+ 364
240	- 40·8	- 11·0	+ 447
245	- 42·4	- 11·8	+ 501
250	- 43·5	- 12·1	+ 528
255	- 45·0	- 12·9	+ 580
260	- 44·4	- 13·1	+ 580
265	- 41·3	- 12·7	+ 524
270	- 39·5	- 11·4	+ 450
275	- 35·5	- 9·1	+ 324
280	- 27·7	- 7·0	+ 195
285	- 13·5	4·8	+ 65
290	- 5·9	- 2·6	+ 15
295	+ 10·6	+ 1·2	+ 13
300	+ 15·7	+ 3·3	+ 52
305	+ 17·6	+ 5·2	+ 92
310	+ 20·0	+ 7·0	+ 140
315	+ 24·0	+ 8·4	+ 202

TABLE III.—*Siemens Machine.*

Position of contact. Degrees.	Pressure. Volts.	Current Amps.	Power. Watts.
225 +	+ 16·7	+ 4·8	+ 79
225 + ⅓	+ 4·2	+ 2·5	+ 11
225 + ⅔	- 3·5	+ 0·4	- 1
230	- 10·4	- 1·4	+ 15
230 + ⅓	- 18·7	- 3·9	+ 73
230 + ⅔	- 25·7	- 8·5	+ 219
235	- 28·6	- 10·0	+ 286
235 + ⅓	- 31·0	- 10·5	+ 325
235 + ⅔	- 34·0	- 10·6	+ 361
240	- 36·1	- 10·5	+ 378
240 + ⅓	- 37·3	- 10·4	+ 387
240 + ⅔	- 38·1	- 10·4	+ 396
245.	- 37·9	- 10·0	+ 379
245 + ⅓	- 37·4	- 9·7	+ 362
245 + ⅔	- 39·0	- 9·7	+ 378
250	- 41·7	- 10·5	+ 435
250 + ⅓	- 42·6	- 11·3	+ 483
250 + ⅔	- 26·0	- 7·5	+ 196
2-5	- 9·9	- 4·5	+ 45
255 + ⅓	- 1·9	- 1·9	+ 3

TABLE IV.—*Ganz Alternator,* 40 *alternations per sec.*

Volts on lamp.	Current in lamp.	Watts in lamp.	Angle to horizontal to left.	Illumination H. U.	Angle to horizontal right.	Illumination in H. U.	Mean spherical intensity per watt below horizontal.
			Deg.		Deg.		
29·7	9·4	257	0·0	78·3	0·0	51·8	0·716 H · L.
,,	9·3	259	8·4	101·0	8·8	70·3	
,,	9·3	262	15·6	148·0	16·4	103·0	
,,	9·4	262	22·0	211·0	22·9	148·0	
,,	9·4	262	28·0	270·0	29·0	191·0	
,,	9·4	262	33·8	285·0	34·5	219·0	
,,	9·4	262	36·2	303·0	37·1	234·0	
,,	9·3	260	38·7	324·0	39·6	249·0	
,,	9·4	262	41·4	316·0	42·1	249·0	
,,	9·4	263	43·7	320·0	44·8	248·0	
,,	9·4	263	45·5	340·0	44·9	240·0	
,,	9·6	264	47·5	360·0	48·8	240·0	
,,	9·4	265	52·4	380·0	55·2	219·0	
,,	9·4	265	59·0	342·0	62·7	187·0	
,,	9·4	265	63·4	314·0	75·9	73·7	
,,	9·4	265	78·6	87·7	83·1	60·7	
,,	9·4	263	—	—	86·8	69·9	
Av. 29·7	9·4	262					

TABLE V.—*Wechsler Alternator,* 40 *alternations per sec.*

Volts on lamp.	Current in lamp.	Watts in lamp.	Angle to horizontal to left.	Illumination H. U.	Angle to horizontal right.	Illumination in H. U.	Mean spherical intensity per watt below horizontal.
			Deg.		Deg.		
31·1	9·5	283	0·0	203	0·0	96·1	1·003 H. L.
,,	9·4	294	7·5	227	8·2	105·0	
,,	9·6	292	14·5	294	15·8	136·0	
,,	9·5	292	20·6	400	21·9	198·0	
,,	9·3	286	26·6	466	27·7	269·0	
,,	9·3	282	32·0	499	33·2	310·0	
,,	9·3	286	34·6	504	35·5	349·0	
,,	9·3	286	37·1	521	38·2	354·0	
,,	9·3	282	39·5	511	40·8	337·0	
,,	9·3	283	41·8	533	43·0	349·0	
,,	9·3	283	43·9	521	45·6	310·0	
,,	9·3	283	46·2	511	47·8	316·0	
,,	9·3	283	51·4	485	52·6	341·0	
,,	9·3	283	54·7	443	57·6	233·0	
,,	9·3	283	58·7	370	61·3	219·0	
,,	9·3	284	64·3	262	68·6	138·0	
,,	9·3	286	71·0	179	75·8	108·0	
,,	9·3	286	78·8	126	81·8	90·8	
,,	9·3	286	—	—	87·6	60·8	
Average 31·1	9·3	286					

TABLE VI.—*Siemens & Halske Alternator. Freq.* 80 *alternations per sec.*

Volts on lamp.	Current in lamp.	Watts in lamp.	Angle to horizontal to left.	Illumination H. U.	Angle to horizontal right.	Illumination in H. U.	Mean spherical intensity per watt below horizontal.
			Deg.		Deg.		
31·0	9·1	268	0·0	132	0·0	217	1·078
,,	9·2	268	8·1	139	7·5	225	
,,	9·1	269	15·4	174	14·6	262	
,,	9·1	270	22·0	231	22·1	300	
,,	9·0	269	28·0	293	27·2	348	
,,	9·1	270	33·2	367	32·6	406	
,,	9·1	270	35·6	405	35·1	421	
,,	9·0	269	37·9	449	37·5	457	
,,	9·1	270	40·1	474	40·0	442	
,,	9·2	270	42·1	521	42·5	448	
,,	9·1	268	44·1	528	44·7	415	
,,	9·0	268	46·2	542	47·0	405	
,,	9·0	267	51·4	527	53·8	298	
,,	9·1	269	54·2	530	56·6	302	
,,	9·1	269	58·1	453	61·7	226	
,,	9·0	268	62·8	352	70·2	126	
,,	9·1	267	74·5	135	76·2	107	
,,	9·1	268	79·5	129.	89·7	107	
Av. 31·0	9·1	269					

The reflector is not to be regarded as a perfect mirror, and the carbons are of course not perfectly uniform. These variations are only photometrically observable and are not of practical importance. The curve derived from these observations is given in Fig. 12. The spherical intensity is calculated for each direction, and the mean of these two values taken.

In the next table are the results of the Wechsler machine, to which Fig. 13 is the curve. The mean spherical intensity has risen from 0·716 to 1·003 Hefner units per watt. The next table gives the same curve for the Siemens machine, with Fig. 14 as its curve. The spherical intensity is here 1·078 H. U. In Table VII is given a summary of all the experiments made on the machine.

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* Abstract of paper read before the Verband der Elektrotechniker Deutschlands, 1894.

It is seen from these results that the development of light does not perfectly follow the sharp ascents and descents of the curve E. M. F. given by the Ganz machine, and, consequently, the energy is not fully utilized. Smoothing out the curve, as in the Wechsler, immediately increases the light given per watt by 44 per cent.; or, put more vividly, if the Ganz machine were replaced by a Wechsler, one in every three lamps might be removed for the same illumination.

TABLE VII.

Machine.	Frequency.	Mean volts on lamp.	Mean current in lamp.	Mean energy consumed.	Illumination in H.U.			Mean spherical intensity under horizontal.	Mean value H.U.
					Horizontal.	Vertical.	Maximum.		
Ganz and Co...	4800	29·9	9·8	271	74	50	341(50°)	0·684	0·710
	"	29·9	9·8	275	75	55	323(51°)	0·699	
	"	29·9	9·8	273	78	55	330(54°)	0·729	
	"	29·9	9·6	267	75	50	343(51°)	0·736	
	"	29·9	9·6	269	58	55	3[illegible]0(53°)	0·719	
	"	28·8	9·6	259	70	45	310(50°)	0·722	
	"	28·8	9·5	256	68	47	310(51°)	0·685	
	"	29·7	9·4	262	66	57	312(48°)	0·716	
	"	29·9	9·3	264	53	60	323(51°)	0·703	
Wechsler	"	31·0	9·5	286	157	60	463(42°)	1·038	1·024
	"	31·1	9·3	286	145	70	437(42°)	1·003	
	"	31·1	9·4	286	160	70	417(43°)	1·010	
Siemens and Halske	7200	31·0	9·5	272	155	80	423(43°)	1·067	1·060
	"	31·0	9·5	277	130	75	475(44°)	1·047	
	"	30·9	9·6	268	157	55	430(43°)	1·046	
Siemens and Halske	9600	31·0	9·1	269	160	80	600(44°)	1·078	1·110
	"	31·0	9·0	269	115	60	500(47°)	1·143	

Wechsler.............	0·906 0·906	0·906	0.900 0·914	0·907
Siemens & Halske.	0·897		0.911	

The third machine, that of Siemens & Halske, could only give the required volts at a higher frequency. When the frequency is raised 33 per cent. the light rises about 6 per cent. It is not impossible that the light evolved rises with the frequency, and Blondel holds it for certain, but our experiments do not furnish any very clear evidence one way or the other. On the other hand the observations on the third machine also show the same kind of difference in intensity of illumination when compared with the first.

From the form of the curves certain important conclusions may be drawn with regard to the illuminating power of arc lamps. If we take the ratio of the simple mean current M (J) to the value measured $\sqrt{M(J^2)}$ and similarly for the E. M. F., we find

	$\frac{M(E)}{\sqrt{M(E^2)}}$	$\frac{M(J)}{\sqrt{M(J^2)}}$
Ganz & Co..............	0·783	0·656
Wechsler................	0.906	C.907
Siemens..................	0.897	0.911

For a true sine curve the value should be 0·900. Since the value 0.907 differs by 28 per cent. from 0.656, and the photometrical measurements, which cannot be made with the same accuracy, give a ratio of 30 per cent., we may consider these as equivalent. There is thus ground for the conclusion that the development of light of an alternate current arc lamp is proportional to the simple mean value of the current.

If we try to make $M(J) / \sqrt{M(J^2)} = 1$, then the current curve must have the shape shown in Fig 15, which approaches that of the Siemens machine; and the extra illuminating power may be partly due to this, as well as to the increased frequency. Unfortunately there is only one curve to be dealt with, giving the value $M(J) / \sqrt{M(J^2)} = 0·911$, and for the photometric observations there are only two sets, giving a value of 1·110, so that no definite conclusion can be drawn. But falling back on the first two results, we see that if the light varies as the simple mean value of the current, the quantity of light should rise from 1·024 to 1·13; and the lamp would give for a current maximum of 10 A a quantity equal to 1·13. Apparently it would be best to build machines whose curves approach the shape of Fig. 15.

There is, however an objection to the universal use of such curves; for if we take into consideration other phenomena we find that while with the Ganz machine the ordinary hum of the arc is increased to a rattle so loud as to make its use impossible in a room, the Siemens machine only makes an ordinary, but loud, humming, while the Wechsler machine makes the lamp burn almost silently. The same phenomena occurred with a Helios lamp. Taking this into consideration, we see that the sine wave gives the best results; the development of light is fair and the arc is silent.

In conclusion, we draw a comparison between the amount of light developed on direct and alternating currents. The experiment was made with a Siemens differential lamp, using a cored carbon 10mm. in diameter and a homogeneous one 3mm. The method and arrangement were as before, the current being supplied by accumulators:

Mean volts in lamp.	Mean current in lamp.	Mean watts in lamp.	Mean spherical intensity under horizontal per watt.	Mean.
46·85	9·26	433·8	2 80	2·84
46·85	9·29	435·2	2·90	
46·85	9·25	433·4	2·82	

We have an average value of 2·84 H. U. per watt, which is very high, partly because of the very small lower carbon, and secondly, because we are dealing with higher amounts of power. If we avoid this by taking a case of a lamp of about the same power, as taken from the table on page 149 of Herr Heim's book, "Die Einrichtung Elektrischer Anlagen," we should have a value of 2·64 H. U. per watt. It is, therefore, evident that for a given consumption of energy the illuminating power of a direct current arc is considerably higher than that of one run by an alternate current. This result confirms that already published as the results of experiments at Frankfort. A large part of this unfavorable result is due to the reflectors, which only reflect about 70 per cent. of the light evolved, and there lies here some room for improvement.

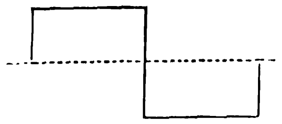
FIG. 15.

If we put in series on a 110-volt circuit two of these direct current arcs taking 6·8 amperes at 42·4 volts, and, on the other hand, with an alternate current circuit at the same pressure, use four alternate current arc lamps, we have the following output of light:

The direct current has an energy of 748 watts, of which 2 × 288·3 = 577 watts are used in the lamps, and 171 in the resistances, and the light evolved is 577 × 2.65 = 1,528 H. U. mean spherical intensity under the horizontal.

With alternate current arcs taking 9·42 A., and using about the same power, all the energy is used for production of light, and with a sine curve (using table VII) we produce

$$4 \times 286·8 \times 1·024 = 1,175 \text{ H. V.}$$

mean spherical intensity under the horizontal. Thus this arrangement also is more efficient with direct than with alternating currents.

Integrators, Harmonic Analyzers and Integraphs.*

BY PROF. O. HEINRICI, F. R. S.

The first planimeter, properly so called, was invented by a Bavarian—Hermann—who, however, published no description of his instrument. A little later, Gonnella, of Florence, reinvented practically the same instrument; but, from the want of skilled labor in Italy, he was compelled to send his designs to some of the watchmakers in Switzerland in 1825. In the following year a Swiss engineer, Oppikofer, brought out practically the same design.

According to an estimate made by Bauernfeind, of Munich, at this period a billion areas had to be estimated annually in Europe, so that the practical importance of getting a reliable instrument was very great.

An instrument on Oppikofer's design was made in France by Ernst, and was there known as Ernst's planimeter. In England, about this time, Sang's planimeter was made. In Germany improved instruments of the same type were known as Wetli-Hansen planimeters. They are all practically of Gonnella's and Oppikofer's design, with very little difference.

In 1854 Amsler made his first planimeter, which created quite a revolution in this class of instruments. His first paper on the subject was published in 1856 and contains a great mass of information on various types of planimeters.

Classification of Planimeters.—Prof. Hele-Shaw in his paper on "Mechanical Integrators"† bases the classification of planimeters on the mechanism used, and particularly on whether slipping or no slipping takes place. A better classification seems to me to rest on their geometrical properties.

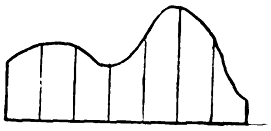
FIG. 1.

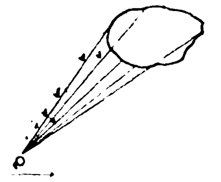

FIG. 2.

Sir Frederick Bramwell, at the Brighton meeting of this Association, gave the first account in English of the theory of Amsler's planimeter, and then expressed his surprise and wonder at the fact that there could be any connection between the area of a closed curve and the motion of a tracing point moving round its boundary. At first sight there is apparently no connection. But consider the given area as generated by the motion of a straight line. A line moving in its plane has two motions possible, translation and rotation; the line itself may either be of fixed or variable length. Adopting this as the basis of classification there are three types of planimeter:

(1) In instruments of the first type, or orthogonal planimeters, the area is generated by the motion of a line of variable length which moves without turning (Fig. 1), corresponding to a system of rectangular co-ordinates.

(2) In planimeters of the second type the generating line is of variable length, and always passes through a fixed point (Fig. 2), corresponding to a system of polar co-ordinates.

(3) In the third type the area is swept out by a line of fixed length.

Planimeters of the third type—Let Q T (Fig. 3) be a rod of fixed length l; its motion into any neighboring position Q′ T′ may be decomposed into a motion of translation into Q′ T″, and a motion of rotation through the angle T″ Q′ T′ =

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* A paper read before the British Association.

† Proceedings of the Institution of Civil Engineers, Vol. LXXXII.

θ. The area swept out by the rod is $lp + \frac{1}{2} l^2 \theta$, where p is the length of the perpendicular between the two neighboring parallel positions of the rod. Now, if the rod ultimately return to its initial position, its ends Q and T will have described closed curves. There is a geometrical theorem, which I shall not attempt to prove here, that the area swept out by the rod in a complete cycle is the difference of the areas of the curves described by its ends. Now, if Q moves to and fro along a curve, the area described by it is zero, and the straight line sweeps out an area exactly equal to the area of the curve (T). Therefore area of given curve $= l \Sigma p + \frac{1}{2} l^2 \Sigma \theta$.

But by coming back to the initial position of the rod, $\Sigma \theta = 0$, and

$$\text{Area} = l \Sigma p.$$

Now suppose on the rod there is fixed a wheel

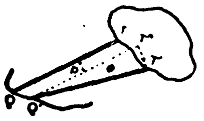

FIG. 3.

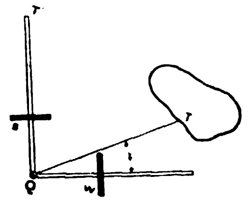

FIG. 4.

which can turn with its axis parallel to the rod, as the rod moves the turning of the wheel will be equal to p; and if the total rolling of the wheel be w,

$$\text{Area} = l w.$$

This is the whole theory of the Amsler planimeter. In the Amsler planimeter the point Q is guided by the pole-arm in an arc of a circle.

I have dwelt at length on this part of the subject because of its importance with regard to the errors of the instrument. It does not matter where the wheel is fixed along the bar, or whether it be on a bar parallel to the original bar, provided its axis is parallel to the bar. In the Amsler instrument non-parallelism is one of the most important errors; the magnitude of the error can be determined as follows:

Let the axis of the wheel (Fig. 4) make an angle ε with Q T; let Q T′ be equal to Q T and at right angles to the axis of the wheel; and let another wheel, whose total rolling is s, be fixed with its axis parallel to Q T′; then it is easily proved that the area

$$(\mathrm{T}) = l \cos \varepsilon,\ w + l \sin \varepsilon,\ s.$$

Hence unless s or ε is zero there will be an error, which is sometimes very serious.

Now the rolling s measures the slipping of the wheel w, due to the motion of translation of Q T′, and this slipping introduces a still more serious error. In 1855, Clerk-Maxwell pointed out that slipping was a serious drawback, and he proposed, but did not carry out, an integrator without slipping.

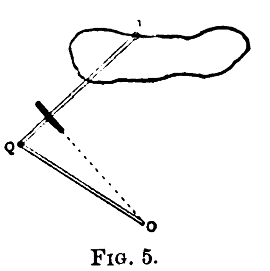

FIG. 5.

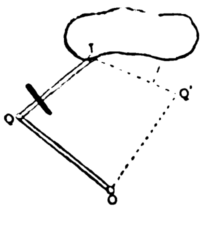

FIG. 6.

The Amsler instrument of 1856 has been improved, especially by Coradi, of Zürich. In Coradi's "precision-planimeter" the wheel rolls on a prepared surface, with the object of avoiding the errors due to slipping. The errors due to slipping depend upon:

(1) The resistance to the slipping of the wheel; and therefore on the nature of the surfaces of contact;

(2) The resistance of the wheel to turning, including the bearings resistance of the rolling wheel and the counter gear;

(3) The amount of slipping of the wheel on the paper.

The errors due to slipping will be reduced, therefore, by reducing these resistances. Again, if the plane of the wheel passes through o (Fig. 5), in moving T on a circular arc with center o the wheel will not roll at all, but slip. Hence, in using the instrument, the pole should be chosen so that such positions are avoided. Coradi has found that by varying the positions of the pole the area registered varies, and has given rules for obtaining the best results. It should be remembered that the Amsler planimeter, by skilful use, is capable of very great accuracy.

Improvements by Coradi.—The Amsler instrument cannot be turned round; but, in a recent instrument by Coradi, the rod and the pole arm are connected by a spherical joint, so that it can be used with the joint first on one side, then on the other side (Fig. 6). The effect of this is to eliminate the error due to obliquity; in one position ε is positive, and in the other negative; thus the most important error in the Amsler planimeter is eliminated.

A number of new constructions have been made with the object of avoiding the slipping altogether. Clerk-Maxwell devised an instrument which has never been carried out. Amsler, also, in his paper of 1856, had foreshadowed a great many schemes which have been afterwards redesigned by others. In his paper of 1884 he designed an instrument with no slipping, but had not carried it out.

A planimeter to be successful commercially must be (1) easily handled, (2) accurate, (3) cheap.

Coradi's Spherical Planimeter.—In this the slipping is reduced to a very small amount, and for ordinary purposes the instrument is of greater accuracy than is really wanted. For engineering purposes the simple Amsler planimeter is accurate enough. For special purposes the spherical planimeter is very convenient.

Another planimeter is that in which the distance moved normally by the rod is measured by the *slipping* of the wheel. A knife-edged wheel rolls on the paper, and can slip along a spindle at right angles to the arm (Fig. 7), thus taking the place of the Amsler recording wheel. Amsler described an instrument of this kind, in which, however, the knife-edged wheel was fixed to the spindle, which again slipped through the rod.*

This instrument has been made in America especially for measuring the areas of indicator diagrams. Now it follows from what I have said about the Amsler planimeter that the sliding rod must be at right angles to the arm. In the Hine-Robertson planimeter this is not the case, and I can conceive no reason for the construction actually used. (Fig. 8.) The rod is bent, and the sliding bar is at right angles to the straight portion of the rod, instead of being, as it should be, at right angles to the straight line Q T. Prof. Perry tells me that in the hands of his students it gave an accuracy greater than the ordinary Amsler planimeter. That the instrument gives good results is due to the fact that the areas measured are small, and that if the indicator diagram be low down the error due to obliquity is very small. In fact, one can get one position for a given area in which the error is zero.

Integrators are not used so much by engineers as they might be. Amsler's moment-planimeter gives—for one tracing round a given curve—the area, the first moment about a given straight line, and a third reading, by means of which with a little arithmetic the position of the mass-center and the moment of inertia about an axis through the mass center are obtained. These are just the three quantities an engineer wants in determining the strength of a beam. Ship builders use it a little more, but not so extensively as it deserves. Amsler has made a few hundred moment-planimeters, while he himself had made over 12,000 planimeters up to 1884.

To return to instruments of Type 1, this planimeter gives always the area from the starting point to any point one likes. If a recording pencil could be attached to the instrument it would be an *integraph*, which draws the integral $f y\, d x$, y as a function of x being given not as an expression, but as a curve drawn on the paper.

The integraph of Abdank-Abakanowicz was one of the first conceived, and is similar to that of Mr. Vernon Boys, a model of which is exhibited. The history of this instrument is

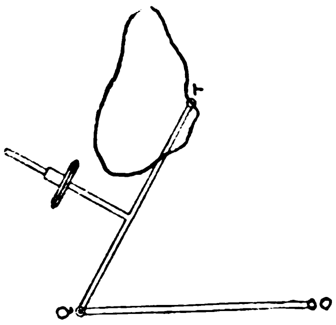

FIG. 7.

rather interesting. Mr. Boys, one evening, had been reading a book on the "Integral Calculus," went to bed, but instead of going to sleep invented the instrument; the next day he began to make it, and on the third day he finished it. A knife-edged wheel rolls on the paper, and is guided so that the tangent of the angle its plane makes with the axis $o\,x$ (Fig. 9) is equal to the corresponding ordinate y of the given curve. The ordinate Y of the curve, described by the knife-edged wheel, is then such that

$$\frac{d\,\mathrm{Y}}{dx} = \tan \varphi = y, \text{ and therefore } \mathrm{Y} = \int y\, d\, x,$$

or the curve described by the knife-edged wheel is such that its differential coefficient is equal to the ordinate y of the given curve. To make the wheel actually draw the curve on the paper, a piece of thin blackened paper is placed blackened side downwards between the wheel and the drawing paper—a very clearly defined curve is the result.

Abdank-Abakanowicz introduced the same principle in his design, which he submitted to Coradi, and the instrument exhibited is the result. If one is given a function—not by an expression, but by a curve—the instrument will give the integral of the function as a curve; so that, for engineers, I think integraphs have a great future.

I think the first conception of an integraph is

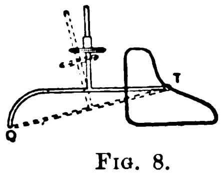

FIG. 8.

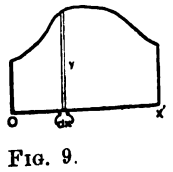

FIG. 9.

due to Lord Kelvin; but in the instrument suggested by him the integral is recorded on a cylinder, and not on a drawing board, which is more convenient. He also mentioned that it would be possible to design instruments to give integrals of certain differential equations. His brother's cylinder-ball-and-disc integrator forms the basis of this design.

Sharp's integrator is not based on the *tangent* principle, but on what might be called the *sine* principle. It is curious to consider how the mechanism of this integrator reduces to somewhat the same thing as in *tangent* integraphs, but the geometry is essentially different. I have had this model made; it was only finished a few days ago, so that practical tests have not been made. It is essentially an integraph; but by the addition of the third carriage, as in the model, one can integrate the differential equation

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* See the "Electrician," Vol. XXVI., p. 432.

$$\frac{dy}{dx} + ay + f(x) = o,$$

a being a constant and $f\ (x)$ being given by a curve. If I move the tracer over the given curve $f(x)$, the pencil draws the integral of the differential equation. If one wants to integrate differential equations of higher order, additional integrators must be added to the instrument. Any linear differential equation of the second order might be integrated by Sharp's instrument; the mechanism would not be too complex.

A great many observations are obtained by physicists and recorded as curves. It seems to me that to be able to work with these curves, as with expressions, is very desirable. I have no time to enter into this now; to see what means there are in existence for dealing with curves the results of observations, and to see whether these means cannot be generalized.

It would be desirable to have differentiographs but the mechanical differentiation of a given curve seems so far impossible. The only way I think possible is to have the given curve engraved on a plate of metal, so that the tracer follows the curve accurately. It is quite impossible to get a satisfactory differentiator in which the tracing point is guided by hand.

Harmonic Analyzers will give the equation to a curve if the curve itself is given. Amsler, in 1856, gave designs for a harmonic analyzer; but the first carried out was by Lord Kelvin for the analysis of tides. One of his designs is at the Meteorological Office and has been used for years. This is quite a large, heavy instrument, and cannot be moved about.

Some years ago I thought, in following Clifford's remarks on Fourier's theorem, that a simple harmonic analyzer could be got, and devised the instrument here shown, in which an Amsler planimeter rests with its pole and recording wheel on a plane surface subjected to a simple harmonic motion in its own plane, while the tracer moves along a fixed straight line.

I then, by transforming the integral, designed another instrument, which gave two coefficients for one tracing of the curve. I then adopted an inversion by Mr. Sharp, and got another instrument made by Coradi. Last year he proposed the addition of a sphere, and the mechanism comes very near that of Prof. Hele-Shaw. This instrument works so very easily that I cannot express my admiration sufficiently for the skill which the instrument maker has put into it. That the instrument is so perfect is altogether the work of Coradi. It will give the first five terms of Fourier's series, i. e., ten integrals for going once round the curve.

Applications.—Obvious applications are to the analysis of meteorological observations, and to the analysis of dynamo curves of varying strength, etc. Prof. Perry, for instance, tells me that his knowledge of valve gears of steam engines has been greatly increased by submitting their motions to harmonic analysis.

The Allegheny City Contract.

The Select Council of Allegheny City, Pa., have voted to award the contract for apparatus for 500 additional arc lights to the Western Electric Company of Chicago.

The Electric Brake in Practice.*

BY ELMER A. SPERRY.

Enterprise in the United States for the public convenience of her citizens is truly phenomenal, and reaches its highest expression in conveniences for travel. The per capita investment in the cities and larger towns of this country for electric street railroad work is much larger than is often realized; in some no less than $55 is invested for each man, woman and child for accommodation in intramural travel. The enormous aggregate sum thus invested has given a stimulus to engineers, resulting in wonderful advancement and refinement in means for mobilizing the thousands of tons of human freight that are hourly seeking transport. Vast skill and almost untold resources have been devoted to perfecting means for overcoming inertia and quickly accelerating cars and trains, which are ever increasing as to their weight and capacity, with patrons constantly more exacting as to speed and smoothness of operation, and especially as to safety. It is proverbial that while these advancements have been going forward, comparatively no attention has been paid to the mechanism for retarding and quickly but smoothly bringing the cars and trains to a stop.

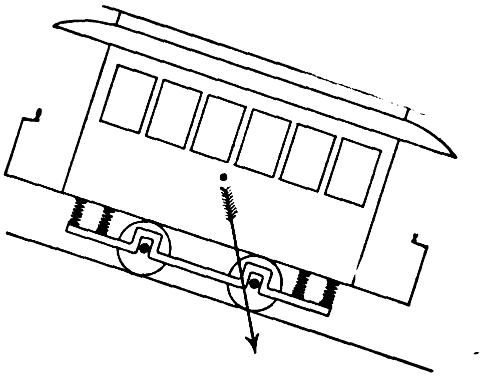

Fig. 1.

As the practice of the steam railroad engineer as to roadbeds, speeds and weights are gradually approached, his experience in the solution of this most important problem of braking should be studied with care. In so doing, however, the features wherein the street car problem is differentiated from the steam road problem should be kept prominently in mind. We must remember that the locomotive engineer is provided with a complete, expensive and somewhat intricate apparatus with which to de-energize his train. The periods of its application are comparatively infrequent, and as to personal capabilities, he is schooled and trained for years before ever being allowed to touch either the throttle or the air valve. While working, his pressure gauges allow him to adjust the brake application to a nicety. Moreover, the time allowed for the total retardation and final stopping of his train is usually very long as compared with that allowed in street railway practice.

Of the two, the street railway problem is the more exacting, and in the hands of far less experienced operators; and yet we are told that the mechanism involved in its solution must bear only a small ratio to the cost of the total equipment. Owing to the recently developed relation between effective braking and the accident and damage account, the purchaser will be spurred on to careful investigation as to the brake applied to his cars, and will be willing to spend sufficient time and money to effectually control retardation as well as acceleration of the car. To be sure, as little expense should be incurred here as possible, but enough to fully meet the requirements. Especially is this true now that ample power for applying the heaviest brakes is at hand, and even if used in a wasteful and extravagant manner in the largest amount possible, is entirely without cost, and its means of control already at hand.

Examination of accounts of the electric street railway companies of our large cities reveals the fact that the item of damage, already very great, is one of growing importance. Investigation of the circumstances and detailed statements of numerous items taken at random from the damage account, point at once and in no uncertain way to the inefficiency of the present hand brake. In many instances, could the car or train have been stopped within a comparatively short distance, the accident and resultant damages would have been entirely averted. Some of our municipal authorities are taking action with reference to the increasing frequency and severity of accidents, and although no thorough scientific investigation of the matter has been published, yet it is a startling fact that with the present hand brake, no electric or other equipment today stands provided with anything in the line of an emergency brake. In so grave and urgent a case, what can be done in the line of remedy? The question naturally arises, will any system of braking worked upon or in connection with the ordinary wheel of a vehicle be sufficient for the stop required? What is the maximum efficiency obtainable by the brake working through the wheels? Is it sufficient to arrest the car before accident in case of emergency? Can it be made in any event a sufficient accident preventer? The popular notion that most accidents are due to brake failure is true, but in a way that is little understood, the failure being one of degree. It may not be known that under proper and standard conditions any car or train may be brought from a speed of ten miles an hour to absolute rest inside of ten feet. It is not generally appreciated that the wheel brake has ample capacity to accomplish this. The former investigations of the writer with reference to adhesion under conditions of acceleration and retardation, climbing and descending hills, afford ample proof that the rail adhesion through the wheels gives the wheel brake more than capacity sufficient to accomplish this result. For instance, assuming any weight and load, say 17,000 lbs., the stored up energy, 64,426 ft. lbs., can with ease be dissipated within 20 ft. for the ordinary equipment, and less than half of this distance, or a little over 9 ft. under conditions of coupled drivers, or if the wheels are compelled to revolve in unison. This latter consideration will be seen to have quite an unexpected as well as pertinent relation to the problem. It will be seen by a glance at the figures that the center of gravity of the mass is far above the wheel contact with the rail. The retarding effect takes place on the base line in a plane below that of the center of gravity, really the farthest projection downward of the mass as a whole. A sudden stop operating on this base line tends to pitch the upper portion forward, bringing nearly all of the weight, and with it the retarding capacity, upon the front pair of wheels. The brakes on the rear pair in the ordinary equipment will have but little effect; if, however, by any practicable method they are coupled to the forward drivers, the brakes on this rear pair still remain active and of full effect. This is true even if the back pair should be lifted clear of the track. With increased weight upon the forward drivers comes ample increased adhesion, thus preserving the full tractive effort of the total weight intact for purposes of stop which is impossible in the ordinary equipment. These effects are all aggravated in case of short wheel base. The present tendency toward a longer wheel base is a step decidedly in the right direction and should be encouraged. The effect of shifting the load in reference to the axles will be especially noticed in descending hills, as shown in Fig. 1, where the momentum of the rapidly retarded mass tends to shift the load centers still further forward, in some cases almost wholly onto the front drivers. It will be seen to have a greater effect than in *ascending* grades, where in stopping, the inertia tends to correct the position of the shifted load, whereas going down, in stopping, the momentum as stated tends to still further aggravate the condition. The practical effect of this may be seen whenever an ordinary street car mounted upon springs of fair resilience is quickly stopped. The car will be seen to suddenly right itself, having been pitched forward in the process of stopping (see Fig. 2), the front springs being depressed and the rear springs extended. These considerations all go to show in a new light the advantages to be derived from coupled drivers for general street railway service.

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* Abstract of paper read at the 89th Meeting of the American Institute of Electrical Engineers.

Bearing these facts in mind let us turn for an instant to the ordinary hand brake. The ratio in the brake levers will be found in the modern trucks to be anywhere from 6 to 11½, averaging about 8½ to 1. The lever arm of the brake staff will be found to be anywhere from 6 ins. to 13 ins. Assuming 11 ins. as the average, the radius from the center of the brake chain to the center of the brake staff will be 1¾ ins., giving thus 6.28 to 1, or a total leverage of 53.4 to 1 from the operating handle to the brake beam. Two elements now have to be assumed. First, the friction coefficient of the brake shoes acting upon chilled wheels. Second, the power upon the brake staff. The writer has endeavored to cover both of these unknown quantities by actual experiment, giving the results in the tables. Table I was taken by a dynamometer being fastened directly to the brake staff handle in line of the pull of the motorman, a cast-iron brake wheel 16 ins. diameter from center to center of a 1¼ ins. rim bearing the handle. A number of experienced motormen were invited to test their strength upon this handle and careful readings were taken. It was noticed that the right arm of the more experienced motormen was much more developed than the left, a fact which I think has been pointed out before. The extent of this development in the forearm is certainly quite marked, showing that the gripping muscles and weight of the body are the elements brought most into play.

TABLE I.

No. of motorman.	Weight of motorman.	Gradual pull with one hand.	Jerk with both hands on hand wheel.	Emergency jerk with both hands on hand wheel.
6	140	112	185	275
58	200	135	275	385
264	287	145	235	312
62	175	125	212	285
123	153	125	245	310
60	185	150	200	300
26	170	150	275	350
96	155	185	210	325
246	135	110	175	325
287	135	125	250	350
66	160	125	250	405
4*	176	100	200	400
266	185	175	250	375
		Av. 181.7	224	338.23

*9 years in service.
Right arm, circumference of forearm, 12¾ in.
" " biceps, 14¼ "
Left arm, " " forearm, 11⅝ "
" " biceps, 13⅝ "

Columns 1 and 2 indicate respectively the number of the motorman and his weight.

Column 3 indicates the greatest possible steady pull with the right hand on the handle, bringing into play all possible weight of the body.

Column 4 indicates the same conditions as column 3, the motorman in this case grasping the hand-wheel with both hands, some motormen using gloves to prevent their hands slipping. None of the men could maintain these values for more than one-half second.

In column 5 is indicated an "emergency stop." The motormen were told to "break the machine" if possible. In this test the body was braced, sometimes with the knee against the dasher rail, the needle registering the highest jerk usually given with a sudden lunge of the body.

It will be seen that the power applied by the steady pull of the average motorman is about 181.7, and can be made to run up in case both hands and the weight of the body are used, to about 224 average, but this value cannot be maintained. The average values of column 5 cannot be used in these calculations, for the reason that although they show the pressure it is possible to reach by jerking upon the hand-wheel, these pressures cannot be maintained and therefore cannot be depended upon for braking effect. The tests show that the full power that can be maintained upon the brake lever for a sufficient length of time for the purposes in hand does not exceed an average of 180 lbs.

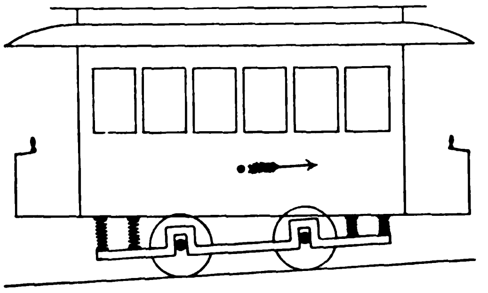

FIG. 2.

(To be continued.)

Economy of Power House Operation.*

BY J. B. CRAVEN.

Economy of power house operation has been so often and so thoroughly discussed that I do not know that I can say much that is new on the subject, and yet being one that must ever come up before the management of a street railway system, I feel encouraged to beg the attention of this meeting for a few minutes, that we may see how and where with intelligent management and proper attention the best results may be obtained on the most economical basis. Starting from the boiler room, we come at once to the place where in most cases the greatest waste will be found. It has been said that the waste due to improper firing is often of greater consequence than any other loss which is produced in the operating of a steam plant. There are two causes for this: First, poor construction of the boiler; secondly, poor firing and lack of care of the boilers. Most of us think that any man can fire a boiler, and whilst looking with awe and wonder at the engine and generator, forget that all the power comes from the coal pile and pay little attention as to the economy in transmitting that power from the coal to the engine. No greater mistake is made than to place the care of boilers in incompetent hands, for they require the highest degree of care, conscientiousness and constant attention.

The fireman must be ever on the watch to see that the water is kept at the proper level, to keep an even steam pressure, and to show by his steam, coal and water records that he is getting just as good cards as the engineer can show by the manipulation of the steam he uses in his engine. He must see that the fires are spread evenly over the grates and are of an even thickness, that the proper amount of air is admitted into the furnace to obtain good combustion.

If you could realize how easily from 1 to 20 per cent. of coal can be shoveled into the furnace and up the chimney without generating any more power, you would see how essential it is to have something more than mere machines shoveling coal into a furnace. Another point of importance is to see that boilers are kept clean and free from scale, which is simply the result of improper attention.

If for a moment you will stop and think that in the construction of the boiler the maker has reduced the thickness of the tubes as much as possible consistent with safety, and then look at a tube with from one-eighth to one-half an inch of scale on it, you will at once see how great the loss must be transmitting the heat through this scale; not only that, but it leaves the iron exposed to the effects of the heat without the proper circulation of water back of it, which causes rapid deterioration, and in some cases is liable to cause an explosion. I have used quite a number of boiler compounds for the prevention of scale, but have found the best to be plain coal oil. We have used it in Buffalo for the past two years with success, putting about one pint a day into each boiler and letting it enter with the feedwater by means of a sight feed lubricator. However, no one remedy will fill all cases, and each must be the subject of some experiment.

Another source of loss comes from insufficiently covered boilers and pipes; see that all exposed parts, that possibly can be, are covered with some good non-conducting material, and prevent as much as possible radiation and condensation. The steam pipes should be kept tight and all leaks followed up at once and stopped, and in this way have as little loss as possible between the boilers and engines. See that the piping is well drained, so that water will not carry over to the cylinder of the engine. This is accomplished by separators placed as near to the engine as possible, and the water thus separated is returned to the boilers. In a good many cases this water is allowed to go to waste. If this is found to be the case it should be remedied, as this water is separated at a very high temperature, and requires very little heat to turn it again into steam. Before entering the engine room I would like to say something on the subject of feedwater heaters. If your engines are running non-condensing, the question is very easily settled; as, however, the majority of steam plants are run condensing other factors are brought in. In the power house of the Buffalo Railway Company, one-seventh of the engine capacity is run high pressure. In this way, taking the feedwater from the hot well, at an initial temperature of 110 degs., and passing it through two heaters in the exhaust line of the high pressure system, we get a final temperature of 194 degs. before the water enters the boilers. It is claimed by some that this method of taking the water from the hot well is not right, on account of the oil to be found in this water. But so small a portion of the hot well water is used that the amount of oil in it is small, and by this method we do away with secondary heaters in the exhaust line, between the engine and condenser, and not only save in the first cost, but I think obtain slightly better results. However, one thing is important, whatever means are used to heat the feedwater, it should be done, for not only will there be a great saving in fuel, but the straining of the boilers due to putting cold water in will be done away with.

Passing from the boiler room we come to the engines and generators, and the types seen here will be many and varied, from the high-speed, belt-driven machine to the slow-speed, direct-connected machine of large units; as you all know, the tendency of late has inclined to the use of the latter type. In my mind there is no doubt of the efficiency of the direct-connected unit over the belted one. It is evident to all that where space is valuable it has the advantage of taking up less room. They can be thrown in and out of service with as much rapidity as the belt-driven machine; there is a saving of from 1½ to 3 per cent., due to the slipping of belts—very little in itself, but when figured up at the end of a year in a plant of any size will amount to considerable.

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* Read at the twelfth annual meeting of the New York State Street Railway Association, September 18, 1894.

Added to this there is the saving in labor and the decreased expense due to wear and tear, as this item is less in slow speed than high speed machinery. For the above reasons I have drawn the conclusion that direct connected units are more economical than high speed ones. Regarding the size of units used, it depends entirely on the output of the plant. I would advocate as large as possible, yet not so large that the breaking down of one would cripple the output. However, in plants that have not these latest types of machines, great saving may be made in the operating of the engines. In many cases after the constructing engineer has left engines are ofttimes supposed to look after themselves, those in charge simply supplying them with steam and oil. What I said in reference to the man in charge of the boiler room applies with equal force here. Put a thoroughly competent man in charge and you will find it a paying investment. Intelligence and experience are the best safeguards and the real insurance against accidents. Fifty dollars a month more to a capable engineer will probably be repaid a hundred times by the care taken and the high state of efficiency at which the machinery is kept. In such a state an engine is a reliable piece of mechanism. If neglected it is liable to fail at any time, causing delays and worries, and not only adding to the expense in the cost of repairs, but a loss in the receipts outside.

A capable engineer will see that his engines are indicated at least once a month, to see that the valves are properly set and so keep the steam consumption down to a minimum. All pounding, knocking and leaks should be followed up and remedied at once, and the engines kept in such a state as at all times to be ready to perform the severest service exacted from them. Always keep the load as near the normal capacity of the engines as possible, as engines at that point are most economical, besides you will have fewer machines in service and thus save in the oil supply. Here I will say a little on the subject of oil, as I think quite a saving may be made at this point; in fact I have had one engineer use $640 worth more of oil in six months than another engineer used in the same time, and the engine capacity was increased during the time the last man was in charge. The lowest priced oil is not always the cheapest; some oils will go much further than others, and the question of what to use should be settled only by careful examination. After being used once it can be filtered and used again on the lighter parts of the machinery. If rags are used for wiping instead of waste they can be washed and used again, and the grease and oil extracted will be found useful in some part of the system. By washing the rags 80 per cent. can be saved over what the cost would be if only used once and thrown away. Coming to the generator, we find a machine that is usually well made and efficient. Keep them dry and thoroughly clean and have the commutator kept as smooth as possible. The principal trouble will be found in the sparking of the brushes and the heating of the armature and the field coils. The causes of these troubles are too many to enter into here; but on the appearance of trouble the machine should be stopped as soon as possible, for the old maxim, "A stitch in time saves nine," can be applied here. As to the minor electrical apparatus in a station, everything, such as switches, connections and all instruments should be kept clean and in working order, especially in the case of lightning arresters, as they may be the means of saving an armature.

In conclusion, I would call your attention to the necessity of having ample copper in the outside lines, and the rails well bonded, and where the system is large enough put in return wires. What is the use of expensive and economical machinery in the power-house if you allow 20 per cent of the power to be expended heating up poor connections in the return circuit?

STREET RAILWAY MEN MEET.

Annual Convention of the Street Railway Association of the State of New York.

The Twelfth Annual Meeting of the Street Railway Association of the State of New York was held at The Yates, Syracuse, N. Y., Tuesday, September 18, 1894.

President Hasbrouck made a short address after the calling of the roll, in which he congratulated the Association on its present condition and future prospects, at the conclusion of which the report of the Executive Committee was presented. It showed that the membership now consists of thirty companies, the highest number yet reached. The Forty-second Street, Manhattanville and St. Nicholas Avenue Railroad Company of New York City has withdrawn, but the Syracuse Street Railway Company and the Hornellsville Electric Railway Company have more than taken the place of the first named company.

The report contained the following obituary notices of members deceased during the past year:

William Richardson departed this life December 31, 1893, in the 75th year of his age. He had been actively engaged in the street railway business for the last thirty years, first with the Dry Dock, East Broadway and Battery Railroad Company of New York, and afterwards with the Atlantic Avenue Railroad Company of Brooklyn, both companies members of this Association. At the time of his death he was the acting president of the former company.

He rose to a high place in the esteem of all who knew him. He was always present at the meetings of this association and took a lively interest in its welfare. From ten years of age he earned his own living in the world, and by indomitable energy and high resolves secured the high position he occupied amongst his fellows at the time of his death. We shall miss his rare counsel in our deliberations, and we sorrow that we shall not look upon his kindly face again.

Henry W. Slocum died April 14, 1894, in the 67th year of his age. He had risen to great eminence during the Civil War, and was a major-general in the Northern Army, with a brilliant record. Shortly after the close of the war he became interested in the Brooklyn Crosstown Railroad Company, and was elected president of the company in 1866, which position he held until the sale of the road to the Brooklyn City Railroad Company.

In 1889 he became president of the Coney Island and Brooklyn Railroad Company, holding the office until a few months before his death, when he was succeeded by his son, Henry W. Slocum, Jr.

General Slocum was a man among men; clear headed, far-sighted, and withal a genial companion and friend. Those who had the pleasure of his acquaintanceship mourn a sincere friend.

Edward F. Drayton departed this life May 27, 1894. He was the secretary and treasurer of the Coney Island and Brooklyn Railroad Company, having been connected with the company since 1860. Of a retiring disposition, he lived a quiet life, faithfully serving the company of which he had been for so many years a highly esteemed officer. His death caused sincere sorrow to his many friends.

We shall greatly miss the faithful and true friends who have gone out from our companionship.

The report of the treasurer was presented and showed the financial transactions of the year to be:

Receipts	$5,860.09
Expenses	5,381.20
Balance	$478.89

The first paper read was by Mr. J. B. Craven on "Economy in Electric Power Stations," which was followed by a discussion by Messrs. Cole, Craven, Seeley and Issertel. The next papers were by Mr. Geo. W. McNulty on "Recent Improvements in Cable Traction," and Mr. Allen R. Foot on "Taxation."

A Nominating Committee was appointed by the President which reported as follows:

President, G. Tracy Rogers, Binghamton; First Vice-President, John H. Moffitt, Syracuse; Second Vice-President, William W. Cole, Elmira; Secretary and Treasurer, William J. Richardson, Brooklyn.

Executive Committee: D. B. Hasbrouck, New York City; John N. Beckley, Rochester; Daniel F. Lewis, Brooklyn.

Place of meeting, Albany, New York.

The report of the committee was approved and the meeting then adjourned.

Exhibits were made by H. W. Johns Co., Consolidated Car Heating Co., Taylor Electric Truck Co., Cutter Electrical Mfg. Co., Davis Automatic Car Shade Co., and Peckham Motor Truck and Wheel Co.

In the afternoon the visitors were driven around the city and shown the various points of interest. An inspection was made of the new track being laid by the Syracuse Street Railway Company.

In the evening a complimentary banquet was tendered to all in attendance and was a pleasant affair, concluding just in time to enable those leaving the city to catch their trains.

The following delegates of railroad companies were present:

Albany—John W. McNamara, Treas. Albany Ry.
Auburn—A. H. Underwood, Treas. Auburn City Ry. Co.
Binghamton—J. Tracy Rogers, Pres't, and J. P. E. Clark, Treas., Binghamton Street Rd. Co.
Brooklyn—W. J. Richardson, Director Atlantic Ave. Rd. Co.
Buffalo—J. B. Craven, Electrician Buffalo Ry.
Charlotte—C. A. Derr, Sup't Rochester Electric Ry.
Elmira—W. W. Cole, Gen. Man'r West Side Street Rd. Co
Long Island City—P. J. Gleason, Pres't L. I. City and Newtown Rd. Co.
New York City—D. B. Hasbrouck, Vice-pres't Metropolitan Rd. Co.
Rochester—J. H. Stedman, Transfer Mag'r Rochester Ry. Co.
Rome—John S. Wardwell, Pres't Rome City Street Ry. Co.
Syracuse—W. R. Kimball, Pres't, John H. Moffitt, Gen. Mag'r, W. P. Gannon, Sec'y, and Paul T. Brady, Director, Syracuse Street Ry. Co.

There were also present:

Belden, A. J., Railroad Contractor, New York City.
Blake, Henry W., Asso. Ed. *Street Railway Journal*, New York.
Brady, Paul T., Agent Westinghouse Elec. and Mfg. Co. Syracuse.
Cicott, Frank H., Ry. Dept. Pettingell-Andrews Co., Boston.
Coles, Stephen L., Asso. Ed. *Electrical Review*, New York City.
Crossman, T. C., Official Stenographer, Brooklyn.
Crowell, Howard H., General Electric Co., Syracuse.
Evans, H. C., Johnson Company, New York City.
Foote, Allen R., Washington, D. C.
Forby, William F., Okonite Co., New York City.
Foster, H. H., Dreher Mfg. Co., New York City.
Fuller, Charles M., Davis Car Shade Co., Portland, Me.
Granger, John A., New York Car Wheel Works, New York City.
Harrington, W. E., Cutter Electrical Mfg. Co., Philadelphia.
Hooker, Thomas, Syracuse Storage Battery Co., Syracuse
Issertel, Henry G., H. W. Johns Co., New York City.
Lawless, E. J., American Car Co., St. Louis.
Le Van, Jr., W.B., Brooklyn Car Works, Brooklyn.
Magee, Frank A., The E. S. Greeley & Co., New York.
Mercur, R. J., New York Car Wheel Works, Buffalo.
Peckham, Edgar, Pres't Peckham Motor Truck and Wheel Co., Kingston.
Porter, H. C., Syracuse Storage Battery Co., Syracuse.
Ransom, ——, Consolidated Car Heating Co., Albany.
Russell, F. D., Rochester Car Wheel Works, Rochester.
Seely, John A., Railroad Contractor, New York City.
Taylor, John, Taylor Electric Truck Co., Troy.
Sharp, Edward P., Webster & Beach, Boston.
Stump, C. E., *Street Railway Gazette*, New York.
Vosburgh, A. C., New Process Raw Hide Co., Syracuse.
Wiley, F. W., Standard Underground Cable Co., Boston.
Wyman, Edward B., Central Electric Heating Co., New York City.
Young, Jefferson, Stilwell-Bierce Co., Syracuse.

The Michigan State Association.

The Michigan Street Railway Association, an organization formed in Grand Rapids last June, held its first annual meeting in that city last week. The railroad men present were: William Canham, W. L. Jenks, Port Huron; David D. Erwin, F. W. Thompson, Muskegon; George A. Hart, Manistee; J. P. Lee, Lansing; Hudson T. Morton, Ann Arbor; David H. Jerome, Saginaw; B. S. Hanchett, Jr., G. S. Johnson, Grand Rapids; Mr. Harry, Bay City; W. Worth Bean, St. Joseph; and among the supply men were Messrs. Kohler, of Chicago, of the Walker Mfg. Company; Smith, agent of the Consolidated Car Heating Company, Albany, N. Y.; Leech, of the Bass Wheel Company; Garson Myers, president of the Standard Railway Supply Company; L. E. Myers, of the Electrical Installation Company; Louttit, of the Pullman Car Mfg. Company, and F. C. Randall, of the J. G. Brill Company.

The subjects of the papers read were as follows:

"Suburban Electric Railways and Their Possibilities," C. M. Swift, of Detroit.

"Construction, Maintenance and Operation of Small Street Railways," W. Worth Bean, of St. Joseph.

"Street Railway Accident and Fire Insurance," David D. Erwin, of Muskegon.

The papers were discussed at considerable length and many valuable ideas in the management and maintenance of railways were developed.

In the evening the members of the Association held an informal banquet at the pavilion of the local street railway company. Toasts were responded to by ex-Governor Jerome of Michigan, Mr. Jenks, Mr. Bowen, Mr. Kohler and Mr. Leech.

After the banquet the supply men, in appreciation of the many courtesies extended by the Association, entertained the latter at the Morton House until long after the hour when street cars usually stop running.

The following officers were elected: President, W. L. Jenks, Port Huron; Vice-President, W. Worth Bean, St. Joseph; Secretary and Treasurer, B. S. Hanchett, Jr., Grand Rapids; Executive Committee, the officers, and David H. Jerome, Saginaw, and Strathern Hendric, Detroit.

The next meeting will be held at Grand Rapids in September, 1895.

An Electric Fountain.

An electrically operated fountain, designed as an ornament to a drawing-room, has been brought out by Louis Heinrici, of Zwickau, in Saxony. The idea is something of a novelty in the United States, but the combination is a perfectly practicable one, and, being self-contained, can be readily removed to various parts of the house, if desired. This ornament consists of a tastefully decorated flower stand, with a small aquarium and a spouting jet of water. Under the level of the plants and flowers is a square zinc tray, containing an electric motor attached to a small pressure pump. The zinc tray also acts as a reservoir for water, and the pump, operated by the motor, keeps a constant circulation through the aquarium and fountain above. Current for the motor is obtained from a battery cell placed on a separate shelf beneath the zinc tray. The battery used consists of a brass cylinder, taking the place of the ordinary battery jar, and an inside brass cylinder, the latter being perforated, to promote the action of the battery fluid. A porous cup with a zinc pole is placed within the inside cylinder. The space between the two brass cylinders is filled with bluestone and the space between the inner cylinder and the porous cup is filled with a concentrated solution of sulphate of copper. Inside the porous cup, surrounding the zinc, is a strong solution of rock salt. This battery is said to be very effective, but when not in use the porous cup must be removed.

New Battery.

An improved primary battery has lately been brought out in England which is likely to be well received by electrical men. It was recently experimented with in an electric launch on the Thames; 30 pounds is the weight of each cell and 48 cells can propel the launch at five miles per hour for ten hours carrying twelve persons. The expense per horse-power is said to be great, but balancing all up pro and con the question of expense applied to the case of an electric launch passes into insignificance. The battery, we understand, is an improved Smee's battery, in which the hydrogen is thrown off by fine filaments of carbon attached to the negative plates. In this battery zinc simply displaces hydrogen, so that although the plates of the battery are carbon and zinc in dilute sulphuric acid and water, the terminal pressure on closed circuit is that due to a zinc hydrogen couple, and not that due to a zinc carbon couple, hence there is only half a volt per cell; this, however, is remarkably constant.

A HAUNTED VIRGINIAN.

He is Bedevilled by some New York Electricians—Who are the Men?

The following remarkable letter, says the Richmond *Dispatch*, was received by the Governor a few days after its date:

SHILOH POST-OFFICE,
KING GEORGE COUNTY, VA.
September 9, 1894.

To His Excellency Governor O'Ferrall:

I address your Excellency. I am a voter and a taxpayer, and yet I cannot live unmolested. There are men that I have located in the city of New York who are in possession of a large quantity of human electricity, with which they can send a current through the atmosphere without a wire, and they use this current and come to Virginia and rob, torture, and torment people who never offended them, and who never saw them. I was cultivating corn this season, and one of their experts followed me over the field and killed the germ of the grain as I dropped it, and whispered in my ear, saying he would send me to the almshouse (this human electricity is a perfect telegraph without a wire), and they have threatened to kill me.

I could mention the names of a dozen good citizens of this county they have killed by entering their system with a current, and by imitating the symptoms of disease, cause death, the imitation being so complete that a physician could not detect the difference. It is not in the power of a single person to bring about their arrest, and I address your Excellency that the power of the State may be used in bringing these men to justice, that we may live unmolested by such a formidable agent as electricity, and that human life can have protection.

Very respectfully.

Current Items.

It is now said they are locating underground water courses by electricity. The account of this from a German technical publication states that an Austrian nobleman, named von Sedczicz, is said to have located 3,000 sources of water in all parts of the world, with but twelve failures, by means of electric apparatus, somewhat indistinctly described, but apparently consisting of platinum chains and balls worn on the body, one end of the platinum chain terminating on the finger, another connection being with a platinum plate on the foot. The other hand holds a magnet and a watch. In walking over a place where there is water in the ground one of the balls "becomes active" and follows the water course, indicating also the depth. The article adds that he also makes a careful study of the topography and geology of the district, which "facilitates" his work.

It is probable that large numbers of the German soldiers will be equipped with portable electric batteries weighing about half a pound. A small lamp goes with it, and the invention will be of great value to the men employed about powder magazines. They are also to be used for signaling from balloons at night, and can be fixed to the helmet when the men have to dig trenches after dark.

An electric switch for street railroads has been invented by Walter V. and J. H. Ash of Newark, N. J. The device is a tongue switch, and it is said to be the first self-setting one of this form ever produced. The motive power is the current from the trolley wire operating upon a horseshoe magnet, which acts upon a right-angle lever rigidly keyed to the pivot of the switch tongue. This pair of magnets exerts a pull of 1,800 pounds with six amperes of current. The arm is released when the carwheels strike a tripping device placed a carlength behind the switch. The current is then cut off from the magnet and a spiral spring throws the tongue back into place. Thus the switch is always set for the main line. If a motorman does not desire to turn the switch, he cuts off the current and drifts over the insulated rail which actuates the mechanism. If he wants to set the switch to leave the main line, he leaves his current on and the switch is automatically thrown to the desired position. The magnets are enclosed in a parafine and sealed up in a water-tight box so that nothing but the iron core projects. This is secured in a cast iron box with a rough surfaced lid, which is bolted down with packed joints to exclude water. Under the tongue the frog is perforated with square holes to allow dirt, stones, snow and other obstructions to fall through into a sump beneath, which will be connected with the sewer. This is easily accessible for cleaning purposes. The dead rail is laid in a box with an insulating compound made of pitch, asphalt, coal tar and flour. The dead rail is connected with the others by means of wooden fishplates, and separated at the joints by wooden plugs and rubber.

Boston Notes.

One of the largest and handsomest switchboards for an isolated plant that has ever been made since the introduction of electric lighting has just been built by the W. S. Hill Electric Company, of this city, for the new Castle Square Theater on Tremont street. There are several 1,000 ampere four-pole switches on the board, which is of blue slate, together with every other necessary device for producing fine illuminating effects. The bus bars and conductors at the back of the board are of massive copper bars, both round and flat, the whole weight of copper being enormous. The W. S. Hill Electric Company is entitled to rank as the foremost firm in the world for switches and switchboards.

The forthcoming Street Railway Convention at Atlanta, Ga., bids fair to be one of the most important gatherings of the kind that have ever been held. Elaborate preparations are being made for an extensive display of street railway appliances. Many New England firms will be represented and delegates will attend from this district in quite large numbers. It is believed a fresh impetus will be given to the street railway business at large by the Atlanta Convention.

The Bell Telephone Company, though disappointed at not receiving just what they needed from the State Legislature recently, pertaining to the increase of their capital stock by $50,000,000, is not likely to allow the matter to remain just where it is at present. The directors are moving again, quietly it is true, with a view to securing all they originally asked for, and with such ample financial resources as the company possesses, it goes without saying that they are not likely to give up the contest until they have obtained just what they want.

There is an inventive genius living in a suburban town near Boston whose life has been devoted to inventing heating devices of various types. He has just completed a new apparatus for burning soft coal culm, with better results in the making of steam than has ever been previously achieved, while for preventing the issuance of black smoke from the chimney stack there is nothing like it in existence. Thousands of people have already seen the working of this apparatus, and all are most enthusiastically impressed with its merits. It saves the money difference between soft coal and hard coal; generates more heat than hard coal, and emits no smoke whatever. It is attracting universal attention, though it is not even yet on the market.

General News.

What is Going on in the Electrical World.

Springfield, Mo.—Bids for electric lighting have been readvertised. October 15 is the date fixed for opening the bids.

Caldwell, Tex.—There is a move on foot here to put in an electric light plant. Very nearly the necessary amount of funds has been secured already.

Pottsville, Pa.—The Pottsville Traction Company has been granted a franchise for an electric railway in this borough. They will build a line to Gilberton.

St. Joseph, Mich.—The car barn of the St. Joseph and Clinton Harbor Electric Company was destroyed by fire on the 13th inst. Several street cars were burned.

Syracuse.—The State Railroad Commissioners have granted the application of the Syracuse Street Railroad Company to use electric power on certain portions of its lines.

Newark, N. J.—A permit was granted last week to the Consolidated Traction Company for its new power house and plant to be erected here, the estimated cost of which is $500,000.

Milwaukee, Wis.—The contract of this city with the Badger Illuminating Company for street lighting will expire on December 15 next, and there is talk of putting in a municipal plant.

New Bedford, Mass.—Mayor Brownell of this city has recently visited Philadelphia and other cities for the purpose of getting information relative to underground conduits for fire-alarm wires.

Carlisle, Pa.—W. F. Sadler, Jr., formerly of Carlisle, has, it is reported, purchased a valuable electric railroad franchise from Pottsville to St. Clair, and a company will be at once organized to build the line.

Richmond, Va.—The council committee on light have adopted a motion recommending that measures be taken for securing an estimate of the cost of constructing an electric plant to be owned by the city.

Weymouth, Mass.—It is probable that a franchise will be granted to the directors of the Braintree and Weymouth Electric Street Railway Company for the construction of their proposed line between Braintree and Weymouth.

Sedalia, Mo.—Surveyors have been fixing a route for the Sedalia, McAllister and Marshall electric railway. It is expected that the road will be in operation by the 1st of December. The company is backed by local and Eastern capitalists.

Oshkosh, Wis.—The franchise granted to J. K. Tillotson in May last to build an electric railway in this city was rendered void by a legal omission. The city council has now, however, passed a legal franchise and Mr. Tillotson will proceed at once with his line.

Burlington, Vt.—The Vermont Electric Company has awarded the contract for the generator and motors, to be used in transmitting power from the station at the gorge to the city, to the Westinghouse Company. According to the terms of the contract they must be in working order in 90 days.

Knoxville, Tenn.—There is a substantial movement now on foot to build an electric line from Knoxville to Powell's Station, a distance of about nine miles. There are local capitalists who have shown a disposition to back up the enterprise, and it bids fair to go through successfully.

Pottsville, Pa.—The Pottsville, Cressona, Schuylkill Haven and Orwigsburg Electric Railway Company have been granted a franchise through Landingville. This company is controlled by the Schuylkill Traction Company, who several days ago secured the right of way through St. Clair.

Lockport, N. Y.—The city council has granted a franchise to the Lockport City and Olcott Electric Railroad Company. Besides the franchise the new company is assigned all the property rights the city may have in the old Lock City Company, also $6,500 forfeiture and $20,000 indemnity bonds given by the old company.

Greenburg, N. Y.—The highway commissioners of this township, in which are the villages of Tarrytown, Irvington, Dobbs Ferry, Hastings and a part of White Plains, have guaranteed a franchise to the promoters of the New York, Elmsford and White Plains Electric Railroad Company to lay rails in the Tarrytown and White Plains road and establish a trolley road.

Ironton, Ohio.—Heald & Holiday, of this city, have closed a contract with the Frazier Highland Construction and Equipment Company, of Chicago, for the construction of an electric railway line between Manchester and Winchester, O., a distance of twenty-five miles, and equip the same, for a consideration of $200,000. The road will probably be in operation by December 31.

Columbus, O.—The Edison Electric Light Company has mortgaged its entire plant to the Ohio Savings Bank to secure the payment of $82,500 bonds. The action is taken so as to enable the company to enlarge and remodel its plant, and was authorized on June 7, 1894, by over three-fourths of the stockholders.—The long-distance telephone line between this city and New York was opened with the usual ceremonies on the 19th inst.

North Attleboro, Mass.—A local syndicate will, it is said, furnish the capital and take out a franchise "for the construction of such electric street railroads in this town as the convenience of the public seems to require." The old track and wires of the defunct Attleboro, North Attleboro and Wrentham Street Railroad will no doubt be made available to some extent. The present plan seems to include a new line, modern equipment, and a power station of ample capacity.

Philadelphia.—Harry T. Paiste, who has for the past year been in the manufacturing business in Chicago, will move his factory East in October. He has formed an incorporated company under the laws of Pennsylvania, to be known as the H. T. Paiste Company, for the manufacture of electrical apparatus. Mr. Paiste will be president of the company, Dr. W. W. Speakman, of Swarthmore, secretary and treasurer, and Prof. J. Russell Hayes is a director. The capital stock is $20,000. The main factory will be located in Philadelphia and a branch house will be maintained in Chicago.

Viroqua, Wis.—This city celebrated on the 5th the introduction of electric lighting by speechmaking, band playing, a ball and other festivities. Besides a general turn out of citizens hundreds of people from the surrounding country were present to participate. Tables to accommodate a thousand at one seating were spread in the open air and the people enjoyed a general feast. The electric light plant was established by two of Viroqua's enterprising business men, W. F. Lindemann and E. W. Hazen. Every business house in town is a patron of the new system and a majority of private houses are already wired.

Buffalo.—The suggestion that there should be a big electric carnival held in this city to celebrate the successful transmission of power from Niagara Falls, when it is assured, is meeting with favor. The *Express* says "the carnival should be the biggest electrical exposition ever held and all the noted electrical companies and manufacturers and others interested in electrical wares of every description should be invited to bring their wares to this city and place them upon exhibition. Buffalo has been talked about for so long a time as the coming electrical center of the universe that hundreds of thousands of persons would come from every section of the country and from other countries to see the wonders."

Boston.—A few days ago while the workmen on the new Worthington building on State street were hoisting a steel beam weighing several tons the chain struck one of the West End trolley wires, the links of which were melted in a moment. Luckily it was a dangling end of the chain that hit the trolley; had it been the upper section, holding the girder, several men might have been injured by the falling beam. But that was not all; the current went through the chain and came down through the wire cable wound on the hoisting drums. The engineer felt the first shock as the engine began to tremble and dropped the winding handles as if they had been red-hot pokers. The strands of the wire rope were so broken and twisted as to necessitate splicing.

Baltimore.—The White-Crosby Company, of Baltimore, although not the lowest bidders, were awarded the contract for the proposed electrical subways in Baltimore. The city engineer, in his report to the Electrical Subway Commissioners, stated that after a careful study of the defects and strong points of the four systems for which bids were offered, in conjunction with the consideration of the cost of the same, he strongly advocated the adoption of the White-Crosby system. The report concluded as follows: "In consideration of the excellence of the designs submitted by the White-Crosby Company, which in my judgment were the most complete and fulfilled the requirements of the specifications more nearly than those submitted by the other bidders, I would recommend that they be awarded the contract for terra cotta conduits, 'Camp class,' at the prices submitted by them in their proposal, which would make the system as proposed cost $63,487.04."—The Maryland Electric Company, J. Frank Morrison president, which was recently awarded part of the contract for lighting the city with electricity, has erected over a thousand poles and hung over 400 arc lamps and is already prepared to turn on the lights.

Albany, N. Y.—There is some talk of forming a company to place in the market the perfect safety guard for electric and cable cars invented by M. F. Smith and James P. Fleming, which has been successfully tested here. The fender consists of a vertical frame hinged to a horizontal one which contains a sliding frame. The framework is covered with netting attached to a catch by means of which the sliding frame is released when a weight is put on the netting. The sliding frame when operated revolves a roller, that is placed in front of the frame, with a motion reverse to that of the car, thus having a tendency to throw anything that it strikes into the netting. Along the sides of the frame are placed guide ropes which also throw anything caught by them into the net. The two sections of the framing are connected by a hinge which allows the horizontal to fold against the vertical so that cars can be coupled without removing the fender.—A preliminary meeting of the incorporators of the Standard Telegraph and Telephone Company has been held here. The company will be organized with a capital of $50,000 to build telegraph and telephone lines in New England, New York and the Middle and Western States. The directors are: Abner S. Adams, Charles J. Glidden, Francis Jewett, James H. Mills, J. W. C. Pickering and Asa C. Russell, of Lowell, Mass.; Arthur L. Andrews and A. Page Smith, of Albany; Charles P. Cummings and Wesley A. Gove, of Boston; and Jesse N. Trull, of Tewksbury, Mass.

A New Firm.

Messrs. A. K. Warren and R. T. Lozier, under the firm name of Warren & Lozier, have succeeded to the business of the New York Electrical Repair Company, and having enlarged premises and equipment at 465 Greenwich street, New York, are prepared to execute all demands in the following branches: Electrical Repairing, Engine Repairing, Installation of Plants, Dynamo Room Supplies, etc. The new firm begins business under favorable auspices, and are apparently well equipped in the technical knowledge and practical experience necessary to complete success in what they have undertaken. Mr. Warren, after taking the Mechanical Engineering course at Kings College, London, divided eleven years of practical experience in mechanical and electrical engineering between the Canadian Pacific Railroad shops, the Worthington Hydraulic Works, a six months' visit to the larger factories abroad, and the balance of the time in the various engineering departments of the Edison and General Electric Companies at Schenectady, New York City and Peterboro, Canada, resigning the superintendency of the New York repair shops of the latter company to organize the New York Electrical Repair Company, in which until lately he has been associated with Messrs. W. W. Morris and Chas. S. Ward.

Mr. Lozier started with the Edison Electric Light Company in 1883, was with Mr. Edison in his construction department and later associated with Mr. Kennelly at the former's laboratory. He had charge of the testing department of the Edison Machine Works, was with Mr. F. J. Sprague at his experimental shop, and passed a year with Leonard & Izard on construction work at Chicago. Later he was engaged in the commercial departments of the Edison and General Electric Companies, resigning the position of assistant to S. Dana Greene, general manager of the lighting department, under whose charge he directed the isolated lighting business of that company.

The American Mineral Wool Company.

The American Mineral Wool Company, whose Eastern office is at No. 2 Cortlandt street, New York City, occupies a place in the business activity of the metropolis peculiarly its own. In demonstrating the uses of Mineral Wool in architecture the company has won well-deserved success by its improved processes of munufacture lately invented and perfected, for which patents have been granted, the wool produced being much improved in strength and texture, lightness and freedom from draughts, over that heretofore made. One of the most important qualities of Mineral Wool is its power to resist the transmission of heat and cold. No other material, either natural or manufactured, which can be used practically in the arts, equals this as a non-conductor of heat, while repeated trials have shown that the liberal use of Mineral Wool makes a better protection against frost than is afforded by any other material. In protecting water pipes from freezing it has been successful where all other means have failed, and the use of corrugated iron lath in connection with a filling of Mineral Wool between the studding is being largely adopted in the construction of buildings by progressive architects and owners. This mode of construction affords the very best plan of protection against fire, short of the use of absolutely non-combustible materials in the entire building. Mineral Wool also possesses a special value as a non-conductor of sound, and is largely used for deafening school-houses in Chicago, Cleveland and other cities. It is likewise a protection against rats, mice, insects and disease germs.

The American Mineral Wool Company was incorporated in 1894 under the laws of New York as a successor to the U. S. Mineral Wool Company, which has been in existence since 1880. The main office is in Cleveland, O., with factories in Stanhope, N. J., and Chicago, Ill., and branches in New York, Chicago, Philadelphia and St. Louis. The officers of the company are as follows: F. H. Prentiss, of Chicago, president; W. C. Andrews, of New York, vice-president; C. H. Rockwell, of Cleveland, treasurer. Mr. H. Franz, manager of the New York office, supplying the trade in New York and Pennsylvania, is a gentleman of experience and reliability with whom it is always a pleasure to do business.

COMMERCIAL PARAGRAPHS.

The Metropolitan Electric Company, 186-188 Fifth avenue, Chicago, report good business and the receipt of several large orders for wire and construction material and new plants entire.

The Berlin Iron Bridge Company of East Berlin, Conn., have erected for the Mather Electric Company a new building, 300 x 50 feet, equipped with improved electrical machinery and a forty-ton electric traveling crane, especially adapted for building large direct-connected generators for railway work. The unfinished castings are brought in at one end of the shop, and are loaded on the cars at the other end as finished generators.

Mr. W. C. McKinlock, secretary of the Metropolitan Electric Company of Chicago, is out of that city on important business connected with his company.

The Metropolitan Electric Company, Chicago, have recently gotten in a large consignment of special split Locust Pins for high class electric light and railway work and are ready to fill orders promptly for these goods. Their N. I. R. Wire is universally called for and sales in this line are increasing.

The Mather Electric Company of Manchester, Conn., report the sale of one of their 180 K. W. improved new type multipolar railway generators, with complete station equipment, to the Hartford and West Hartford Horse Railway Company, for the Hartford, Conn., power-house. The generator is to replace a 200 K. W. generator of Philadelphia manufacture, which, after a two weeks' attempt on the part of its makers to make it run successfully, was thrown out. In thirty-six hours after placing the order the Mather Electric Company had the road running successfully, they in that time having removed the old generator and installed two temporary generators.

The Metropolitan Electric Company, Chicago, are announcing to their patrons that they are handling the Kester Monarch Arc Lamp, representing the F. P. Little Electrical Construction and Supply Company, makers of this lamp, in the West, Mr. W. E. Parker having returned to Buffalo. Mr. Parker had this line in charge during the summer months, making his headquarters with the Metropolitan Electric Company. A stock of these lamps is kept on hand in alternating, direct and constant current, ornamental and otherwise. Shipments can be made promptly.

INCORPORATIONS.

The Scranton Electric Construction Company, Scranton, Pa.—to manufacture electric or steam plants for lighting, drilling and pumping, or electric power generally. Capital stock, $15,000. Promoters: Fred'k J. Platt, Frank E. Platt, Edw. B. Sturges, Scranton.

The Highland Park and Butler Street Railway Company, Pittsburg, Pa.—to construct maintain and operate an electric railway. Capital stock, $12,000. Promoters: H. S. A. Stewart, Jas. J. Donnell, Jno. G. Holmes, Pittsburg.

Interstate Telephone Company, Louisville, Ky.—to operate telegraph and telephone lines, electric lighting and power plants. Capital stock, $2,000. Promoters: T. C. H. Vance, G. L. Hogan, F. A. Vance.

The Zenith Gas Engine and Power Company, San Francisco, Cal.—to manufacture and deal in gas, electric and vapor engines; build and operate telegraph and telephone lines and railroads, electrical machinery and plants, etc. Capital stock, $1,000,000. Promoters: Jno. W. Eisenhuth, Louis F. Dunand, Rudolph Herman, Albert R. Herman, Samuel F. Simrah, San Francisco.

Los Angeles Gas and Electric Fixture Manufacturing Company, Los Angeles, Cal.—to manufacture and deal in gas and electrical fixtures, brass, iron and ornamental work and other articles. Capital stock, $50,000. Promoters: Max Meyberg, Moritz Meyberg, S. Nordlinger, Louis Uhlfelder, Leopold Himmelstern, Los Angeles.

The Charles E. Rich Company, Detroit, Mich.—to manufacture, buy and sell electric fixtures, lamps and bric-a-brac. Capital stock, $20,000. Promoters: Wallis Boileau, Philadelphia, Pa.; Fred'k J. Linsell, Chas. F. Rich, Detroit.

The Electrical Advertising and Sign Company, Portland, Maine—to manufacture and deal in electrical goods and apparatus of all kinds. Capital stock, $100,000. Promoters: Chas. M. Jacobs, Everett R. Reynolds, J. Vipond Davis, New York City.

The Mexican Improvement and Construction Company, Chariton, Iowa—to construct railways, streets, canals, electric light plants, etc. Capital stock, $5,000,000. Promoters: Smith H. Mallory, D.J. Thayer, T. M. Stewart, Chariton, Ia.; E. I. Molera, Ernest Riall, San Francisco, Cal.; Richard C. Cushing, Chicago.

The Reading and Pottstown Electric Railway Company, Reading, Pa.—to construct, maintain and operate an electric railway. Capital stock, $100,000. Promoters: Kurtz A. Fitchthorn, R. L. Jones, M. C. Aulenback, Reading, Pa.

The American Electrical Heater Company, Detroit, Mich.—to manufacture and sell electrical heating devices, electrical cooking devices, dynamos, etc. Capital stock, $5,000. Promoters: Jno. Heffron, Benj. H. Scranton, Fred'k H. Date, Detroit.

The Anti-Friction and Electric Car Wheel Company (incorporated in W. Va.), New York, N. Y.—to manufacture and sell car wheels, etc. Capital stock, $300,000. Promoters: Henry Schulz, Eugene Mayne, Thos. White, Jno. F. Lorenger, New York City.

The New Jersey Electric Railway Company, Paterson, N. J.—to construct and operate electric street railways, etc. Capital stock, $2,000,000. Promoters: Chas. A. Johnson, Brooklyn, N. Y.; Geo. V. Turner, New York City; Frank Irving, Jersey City, N. J.; Jno. McGuinness, Jr., Ridgewood, N. J.

The Philadelphia Suburban Passenger Railway Company—to build a trolley railway in Philadelphia and suburbs about forty-five miles long, double tracked, to connect with the Philadelphia Traction Company's system. Capital stock, $600,000. Incorporators: Geo. B. Widener, David H. Lane, Geo. R. Yarrow, Richard F. Bower and Alex. Rennick.

The Central Ohio Electric Railway Company, Columbus, Ohio—to construct and operate a complete electric railway system between Pittsburg and Chicago, with branches connecting with towns and cities along the route. The articles of incoporation provide for freight, express and passenger traffic, and the hauling of the mails. Among other objects are the supplying of light, heat and power for public and private use, and the construction of a telephone and telegraph line. The headquarters of the company is Mount Vernon, Ohio. Capital stock, $100,000. Incorporators: G.A. Jones, F. W. Jones, J.A. Caldwell, William M. Koons and M. Spellacy.

A certificate has been filed with the Secretary of State at Albany by the State Electric Light and Power Company of Brooklyn, announcing an increase of its capital stock from $200,000 to $500,000. The company's directors include Noah L. Cocheu, William Seward and Jasper N. Raymond.

Jenney Electric Conduit Company, Chicago. Capital stock, $5,000,000. Incorporators: L. A. Farnsworth, Joseph M. Hill, Charles S. Marshall.

The Rockwell Construction Company, Paterson, N. J.—to build, construct, or repair railroads, water, gas or electric works, etc. Capital stock, $30,000. Promoters: Ernest G. Wightman, Middletown, N. Y.; Merle J. Wightman, Benj. H. Throop, Wm. H. Rockwell, Scranton, Pa.; Jas. C. Hinchliffe, Paterson, N. J.

The American Electric Exercising Machine Company, Chicago, Ill.—to manufacture and sell electric exercising machines. Capital stock, $50,000. Promoters: Jas. W. W. Williams, H. J. Weld, W. R. Bullon.

The Kerlin Bros. Company, Toledo, Ohio—to do general contracting and building; construction and operation of gas plants, water works, electric lighting and electric street railways. Capital stock, $10,000. Promoters: Richard Kerlin, Edward M. Kerlin, Wm. A. Gashe, M. P. Murphy, Patrick Henahan.

The Peterson Electric Conduit Railway Construction Company, Milwaukee, Wis.—to manage and operate a conduit system for street or other railways, mills, etc. Capital stock, $500,000. Promoters: A. E. Smith, W. Meyst, H. S. Esch.

The Newtown Railway Company—to operate a surface electric railway between Long Island City and Flushing, L. I. Capital stock, $150,000. Directors: Rudolph T. McCabe, New York City; Cord Myer and Christian M. Myer, Maspeth: George Chambers, Long Island City; Robert C. Pruyne, Albany.

The Electric Traction Company, Limited, Detroit, Mich.—to deal in electrical patents and manufacture and sell electric railway appliances. Capital stock, $150,000. Incorporators: Oliver H. Law, Charles Heinricke and Thos. Harris.

The Northwest Gas and Electric Company, Washington, Iowa—to own and operate gas works. Capital stock, $250,000. Promoters: Americus E. Johnson, Liberty, Ind.; Geo. V. Benedict, Andrew W. Snyder, S. C. Green, Washington, Iowa.

The Euclid Heights Company, Cleveland, Ohio—to construct and operate electric, steam, or other railways; to construct and operate water works, electrical plants, etc. Capital stock, $500,000. Promoters: Pat. Calhoun, Roland R. Conklin, Wm. L. Rice, Geo. A. Laughlin, Allison J. Thompson.

The New London Electric Light Company, New London, Ohio—to manufacture and furnish electric light, power and heat. Capital stock, $4,000. Promoters: D. J. C. Arnold, H. G. Skinner, Chas. E. Reynolds, S. J. McCready, O. G. Carte, Jr., E. R. Stilson, J. H. Beattie, F. R. Hubbard, W. R. Brundage, R. B. Powers, Jno. Kelley.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED SEPTEMBER 18, 1894.

ELECTRIC RAILROADS AND APPLIANCES.

526,142. Bond for Electric Railways. Dwight D. Book, Brooklyn, N. Y. Filed July 14, 1894.

526,183. Trolley-Wire Finder. Edward Gale, Peoria, Ill. Original application filed Nov. 21, 1892. Divided and this application filed Jan. 15, 1894.

ELECTRIC LIGHTS AND APPLIANCES.

526,145. Incandescent Electric Lamp. David J. Cartwright, Boston, Mass. Filed Jan. 27, 1894.

MOTORS, DYNAMOS, ETC.

526,063. Multiphase Converter. Hermann O. C. E. Wagemann, St. Louis, Mo., assignor of three-fourths to Charles Orthwein, same place. Filed July 5, 1892.

526,064. Electric Generator. Hermann O. C. E. Wagemann, St. Louis, Mo., assignor of three-fourths to Charles F. Orthwein, same place. Filed July 5, 1892.

526,083. Electric Motor. Alexander W. Meston, St. Louis, Mo., assignor to the Emerson Electric Manufacturing Company, same place. Filed Aug. 1, 1892.

526,169. Electric Motor. Elihu Thomson, Lynn, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Aug. 30, 1884.

526,170. Dynamo-Electric Machine. David H. Wilson, Chicago, Ill. Filed Aug. 17, 1893.

TELEPHONE AND TELEGRAPH APPARATUS.

526,139. Telephone-Transmitter. Henry L. Baldwin, Chicago, Ill. Filed Jan. 30, 1892.

MISCELLANEOUS.

526,078. Electrical Connector. John B. Henck, Jr., Brooklyn, N. Y. Filed July 6, 1894.

526,114. Process of Electrodeposition of Chromium. Emile Placet and Joseph Bonnet, Paris, France. Filed Aug. 20, 1892.

526,140. Electrically-Operated Register for Barrels, etc. Henry J. Bang, New York, N. Y. Filed April 4, 1894.

526,168. Signal Apparatus. George L. Thomas, Brooklyn, N. Y., and Edward C. Seward, Montclair, N. J.; said Seward assignor to said Thomas. Filed Jan. 22, 1894.

526,172. Electric Switch. Louis Winterhalder, Milford, Conn., assignor to the National Electric Manufacturing Company, same place, and Jersey City, N.J. Filed Feb. 17, 1894.

526,182. Galvanic Chain. Friederike Fritsche, Berlin, Germany. Filed May 12, 1894.

526,220. Electric Indicator. Clyde J. Coleman, Chicago, Ill., assignor to himself and Louisa M. Goodrich, same place. Filed Dec. 8, 1893.

526,227 Electric Cut-Out. Elmer E. Hersh, Denver, Colo., assignor of two thirds to John B. Terbert and Clinton A. Scott, same place. Filed March 7, 1894.

526,356. Dial Transmitter. Frederick Pearce, New York, and Joseph Broich, Brooklyn, N. Y., assignors to said Pearce. Filed June 11, 1894.

RE-ISSUE.

11,442. Secondary Electric Battery. Charles Theryc and Alfred Oblasser, Paris, France. Filed March 15, 1894.

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EDITORIAL NOTES.

Useless Inventions. The fact that an invention to be of any commercial value must fill a general demand, or create the same, is too apparent to require any confirmation, and it is equally apparent that an invention the object of which can be more cheaply and efficiently attained by other means is practically useless and merely represents wasted ingenuity.

The subject is called to mind by the publication of a new English invention for varying the candle-power of incandescent lamps, which in spite of its uselessness seems to present a very attractive problem to inventors, judging from the amount of energy which has been expended in this direction.

It is difficult to see where such an invention will find any application sufficient to warrant its manufacture, as outside of an occasional sleeping apartment the demand is generally for more rather than less light, and even where a dim light is desired the expense and complication of these regulating devices would in nine cases out of ten be sufficient to induce the customer to return to his less costly though primitive taper or oil lamp.

As a dim light can be procured, however, with incandescent lamps, and without the aid of any brilliant inventions, the inventive efforts to secure this object seem all the more unnecessary. The plan of Mr. T. B. Sharp, alluded to above, is to interrupt the current in the lamp by means of a revolving commutator driven by clockwork or other motive power, which is designed to avoid the use of a resistance. The general reader, however devoid of technical knowledge on the subject of electricity, cannot fail to appreciate the folly of paying for a special armature, and the necessary motor to drive it, when the same object can be attained without the use of any other than the usual apparatus.

In almost every case a frosted or colored lamp of low candle power can be substituted for a regulating device, with entire satisfaction and without any additional expense; and even where a resistance is employed, its cost is negligible in comparison to that of a dynamotor or miniature central station for varying the candle power of a few night lamps.

* * *

The N. E. L. A. Meeting Place. It is probably fortunate that some discord has arisen in the Executive Committee of the National Electric Light Association. The announcement of the protest made over the committee's action in designating Cleveland as the next meeting place will no doubt be of benefit in stirring up the members who did not take sufficient interest in affairs to attend the meeting, and show them the necessity for their performing the duties of the offices to which they were elected.

The general feeling of satisfaction which was expressed when it was announced that Cleveland was to be the city for the next annual meeting should make the advocates of that city stronger than before in their contentions. No better place could be chosen. The hotel accommodations are unsurpassed, the city can be reached in one day's ride from almost every point within the limits of the Association's activity; in fact it is an ideal convention town. This fact was proved two years ago when the American Street Railway Association held there the most successful meeting in its history.

Last year the Light Convention was held at Washington, almost at the extreme East; and while the meeting was a record-breaker, it was because of the peculiar attractions of the city, and in spite of the fact that very small delegations from the West were in attendance. To hold the meeting again this year in the far East would be little less than an insult to Western members and their friends.

Those who would be suited with Boston do not comprise 10 per cent. of the regular attendance, and it is difficult to see any reason for the strenuous advocacy of that city for this year's meeting except the desire to always be on the other side.

Boston is a charming city, but to hold the Light Convention there this year would result in a flat failure and a serious drawback to the splendid progress which the Association is making.

Every member of the Executive Committee should be present at the next meeting.

The Unit Industry. We notice that the objections which ELECTRICITY has urged against the adoption of the proposed new nomenclature for the practical magnetic units are strongly endorsed by Prof. Jamieson, who was one of the first electricians to call attention to this subject in a paper read before the Institute of Electrical Engineers, London, some eight or nine years ago. He also makes some suggestions in regard to the symbols adopted for physical quantities, all of which are worthy of careful consideration, as a number of his proposed modifications tend to considerably simplify the present system of notation.

Among these suggestions, which will be found in the tenth edition of Monroe and Jamieson's Pocket Book, a very practical one is the use of plain block letters instead of the French script symbols for magnetic quantities, as the latter are not only an uncommon font of type but are difficult to write on paper and on the blackboard. Another simplification is, several cases can be made by using the reciprocals of certain quantities instead of introducing a new symbol. For example, reluctivity may be expressed by $\frac{1}{\mu}$ instead of ν, which is easily mistaken for v, and conductance ($\mathrm{G}\ g$), being the reciprocal of R, is more simply expressed by $\frac{1}{\mathrm{R}}$. In the same way for mho $\frac{1}{\omega}$ is proposed.

The terms *gauss*, *weber*, *oersted* and *gilbert* are criticised thus: "These will never do. Do we want them?" This query is the keynote to the objection which ELECTRICITY has urged against units, and while we are fully in sympathy with the desire to honor the memory of these distinguished workers in electrical science, we do not believe this should be done at the expense of unnecessary and impractical complications in the notation of electrical units. The multiplication of terms which can be of no practical use, or which are better expressed by the definitive compound words already in general use, deters from the simplicity of scientific nomenclature rather than advances it. And, moreover, even if these unnecessary units are generally adopted in scientific literature, the older significant terms will be very sure to be retained by electricians for practical use.

* * *

The Bell Telephone Company at Louisville, Ky., has about 36,000 miles of wire in operation. Of this 24,000 miles are underground.

THE above item is going the rounds of the daily press. We cannot account for this extraordinary mileage of telephone wire in Louisville, and think likely Lexington was meant, where the equipment was made necessary by the late Breckinridge-Owens campaign. We suppose the 24,000 miles underground were intended to carry the millions of curses uttered by the Kentucky colonels in the right direction, and it is to be hoped they have done their work well.

* * *

SOME burglars never read the papers. Those who cracked the safe in the office of Mr. Muir's railroad at Schenectady the other night, and found it empty, could have saved themselves trouble if they had known that the road was bankrupt.

SHARES of the Electro-Pneumatic Company's stock, par $10, recently advanced in one day on the Philadelphia Board from 25 cents to $1.50 per share. The company is a New Jersey corporation. The capital originally authorized was $1,000,000, but this has been increased to $1,500,000. The business of the company is to operate tubes for delivery and collection of mail matter, packages, etc. It has a line now in operation between the main Postoffice and the East Chestnut street station, Philadelphia.

* * *

THE Boston *Commercial Bulletin* calls attention to the before and after taking effect of the decision against the G. E. Co. in the feeder and main patent case.

Before taking, Mr. Coffin said over his own signature in the last annual report:

"Substantial progress has been made during the year in the prosecution of suits against infringers of many of the more important patents belonging to the company. The 'feeder and main' patent, which is of FUNDAMENTAL IMPORTANCE, particularly for low tension lighting plants, has been sustained by the Circuit Court for the District of New Jersey."

After taking, a director—Mr. Coffin chose here to conceal his identity, but we can't allow his modesty to bury the fact—spoke as follows:

"If the General Electric had won the Philadelphia patent case it would have been a very big thing for General Electric, but losing the case is not so important. The United States Electric Company and the old Edison Company became involved in legal difficulties about these patents, but finally agreed, pending litigation, that both should use the devices. This continued after Westinghouse secured the United States Company and the General Electric Company was formed. If the General Electric Company had won, other companies would have had to pay a royalty, or invented a new process, but as the patent was declared open to anybody, in fact was not a device which could be patented, according to the court, the result simply is that the various companies go on as they have been going on."

* * *

MR. F. A. MAGOWAN, of Trenton, has filed his answer in the suit of the General Electric Company to recover one-half the $150,000 of stock of the Trenton Light and Power Company, which was issued to Magowan by the present company for the franchises and rights of the Edison Electric Light and Power Company.

It is to be hoped that this matter will be fought over long enough so that the actual facts may become a matter of court record. The Edison Company, as organized at Trenton, was a blackmailing scheme and nothing else. Whatever either the G. E. Company or Mr. Magowan has made it is more than either deserved. The only safe way for thieves to conduct their operations is to distribute their spoils in secret.

* * *

IT WOULD be perfectly natural for Mr. O. T. Crosby to identify himself with the Ft. Wayne Corporation, and we guess this is what he will do. He is familiar with the Wenstrom matters, and in charge of the technical railway work at that factory would be a valuable man in the right place.

* * *

MR. SAMUEL INSULL and the Chicago Edison Company may expect vigorous competition in that field at an early day. The plans are well matured.

IN the report of the big fire at Portland, Ore., the other day, it was stated that the Portland General Electric Company suffered a loss of $50,000 from the burning of twenty-five freight cars loaded with new apparatus for their station. We wonder if this was the value of "the largest shipment of electrical apparatus made from an American factory" which Mr. Coffin announced, with a faint trace of his old smile, several weeks ago.

* * *

IT is with a feeling of pardonable pride that we call attention to an original poem, which we have been fortunate enough to secure, from the pen of Mr. Bloodgood H. Cutter, the Long Island Farmer Poet. Our older readers will need no introduction to this celebrated writer, whose contributions appeared frequently in leading publications a few years ago, and we take pleasure in making him and his charming style known to our younger constituency. Mr. Cutter was one of the distinguished gentlemen who made the trip around the world in the good ship Quaker City, and was the "Poet Lariat" of Mark Twain's "Innocents Abroad." It was to him that Mr. Clemens referred, when he wrote of Mr. Beecher's inability to be with the party: "There were other passengers who could have been spared better, and would have been spared more willingly." It is a historic fact that Mr. Cutter had a new poem to read at breakfast every morning for the six months which this trip lasted, and that he could not be stopped by threats of being thrown overboard or placed in irons for mutiny. His inspiration is perennial, and his muse is with him under all conditions. It was known to us that he had written poems on almost every known subject, including A Rail Fence, A Load of Hay, and A Rotten Turnip. By presenting the argument that his literary memoirs would not be complete without an electrical poem, we persuaded Mr. Cutter, who yielded to our request. The Electrical Poem will be known as one of his choicest productions, and we trust our readers will cut it out for preservation, as it will be a long time before we shall print anything else from the Farmer Poet's pen.

* * *

THE TIME was when the New York *Sun* had an arrangement with men who were recognized authorities in the various professions, trades and sciences, whereby the editorial comments of that paper on any subject requiring expert knowledge were sure to be correct and valuable. It is evident that this admirable plan has been abandoned, or that no electrical authority has been added to the list. It required no expert knowledge, however, to save our contemporary from the unpardonable blunder of mentioning in one sentence and in all seriousness, as if belonging in the same class, Barrett, Tesla and Edison. Even the dynamo tender in the basement could have given the editor information as to these gentlemen. Edison and Tesla no doubt belong in the same rank. Barrett is not an electrician at all, but a good politician and a good fellow, who is to Chicago politicians (save in avoirdupois) what Mr. Thomas Costigan is to the New York politicians. Edison has already written in regard to this National School: "I suppose the Dean business is purely honorary--I neither write nor lecture." We will inform our contemporary, moreover, that the leading electrical authorities of America were not mentioned in the paragraph referred to. Is it possible that a paid reading notice has crept into the editorial columns of the New York *Sun*? If so, the responsible rascal should be turned out.

* * *

WE NOTE that Mr. John L. Martin, whose unjust treatment at the hands of the U. S. Accident Association of New York and the Travelers of Hartford was mentioned by us some weeks ago, has begun suit against these companies to collect the money which is due him, and which should have been paid six months ago. We believe Mr. Martin will win, but that will not relieve the companies from the severe condemnation of all who know of their unfair action.

* * *

ELECTRICITY was criticised somewhat for the tone of its remarks in regard to the Brooklyn Tabernacle and the peculiar business methods of its managers. We desire all our critics to know of the latest scheme evolved among them for raising money:

> An admirer of the Rev. Dr. Talmage has conceived a plan for providing funds for the erection of a new Tabernacle, and some of the trustees have given it their individual approval. He proposes an issue of bonds of $1.00 and upwards, non-interest bearing, and payable in twenty years. Each bond is to be made valuable by a picture of the Tabernacle and of Dr. Talmage and his autograph. He thinks that $300,000 could be easily raised in this manner, and that very few of the bonds would ever be presented for payment owing to their value as souvenirs.

The business history of the Tabernacle would not warrant any investment in these bonds except as souvenirs.

* * *

ONE OF the possible ways which the Edison licensees might adopt to secure better prices and better apparatus would be to make a demand that the Edison Electric Light Company take the manufacture of Edison apparatus out of the hands of the G. E. Co. This is one of the many plans which are under consideration.

ANOTHER FAILURE IN CHICAGO.

The firm of Taylor, Dee & Mack, Chicago, dealers in electrical supplies, assigned on October 1 to Mr. F. S. Terry. Mr. William Taylor was the senior member. It is supposed the failure was precipitated by the collapse of the Knapp Electrical Works.

Are Barrett and Hornsby Philanthropists?

Hornsby Says So.

(From the New York Recorder.)

Dr. J. Allan Hornsby, the engineer and inventor who won a national reputation as chief electrical engineer at the World's Fair in Chicago, is in this city to look after the organization of a National School of Electricity. . . . The object of the school is purely philanthropic.

[This school would command more confidence if its promoters were not humbugs and charlatans, giving themselves fraudulent titles and sailing under false colors.

Hornsby is no engineer, and his only recorded invention is that of his own title of Doctor, if we except the story that he was educated abroad.

A philanthropist should not be a liar.]

AN ELECTRICAL POEM.

BY THE LONG ISLAND FARMER POET.

Electricity does now appear
As the Creator's agent here—
From lightning flash in the dark sky
The dreadful thunderbolt does fly.

So terrible when it does strike,
We do not know what it is like;
When its effects we duly scan
It seems beyond the power of man.

Wonderful the Electric Light,
So quick and brilliant in the night!
How far this wondrous light will go
The distant objects plainly show.

With this light on the raging sea
So quick the ship can lighted be,
With it can send a light ahead
To show the danger they do dread.

On trolley cars its power does show,
So quick and fast it makes them go;
So easy can its power control
Astonishes a human soul.

Its uses are now so very great,
Too many to enumerate.
By it words come by telegraph,
Some they make weep, and others laugh.

More wonderful it seems to be
To send words through the raging sea;
Although the distance is so great,
Can extend them from State to State.

Words sent to England on the line
Do seem to go ahead of time;
Words sent from England over night
Are printed here ere morning light.

By Electricity cook our food;
In many ways does so much good;
Use it most every way we will,
The sick to help, the bad to kill.

Lightning has often struck my place,
Once felt it even in my face;
So quickly it affected me
For a few moments could not see.

Once lightning struck my vessel's mast,
Above our heads did slivers cast;
Some blocks did smash, some ropes did burn,
Then overboard its force did turn.

Terribly pieces flew in the air,
As if it would destroy us there;—
So thankful was myself and crew
When from us it so quickly flew.

When we the effects of lightning scan
We feel how helpless then is man.
What are great ships and armies then?—
By lightning stroke be with dead men.

Over one hundred thousand men, I've read,
In one night they were stricken dead,
Of the first-born in Egypt, too—
Fell one night by Electric blow.

By it, the Scriptures also tell
How Sodom and Gomorrah fell;
Old Pompeii in a later day
Was soon destroyed in a like way (?)

I've also read how Babel's Tower
Was destroyed by Electric Power.
Terrible must have been the blow
To lay that famous tower low!

It seems this power has oft been sent
On mankind as a punishment,
So it behooves all to take heed
Or the like may come on us indeed—

Electricity, by God's command,
Melt and dissolve the solid land,
So terrible the heat would be—
Dry up also the raging sea.

St. Peter tells us of a day
When Heaven and Earth will melt away,
So it behooves all to prepare
For that dread day with earnest care.

BLOODGOOD H. CUTTER.

Little Neck, L. I., Sept., 1894.

The Elwell-Parker Electric Company of America.

The Elwell-Parker Electric Company of America have begun business, with headquarters in Cleveland, Ohio. They have secured control of the works of the Browning Machine Company, at Belden and Hamilton streets, which are already well equipped for the manufacture of the heavy machinery which will be the specialty of the concern.

The Elwell-Parker systems in England are under the control of the Electric Construction Corporation, one of the leading concerns. Their English works are at Wolverhampton.

THE CINCINNATI EDISON CO.

A Dangerous Word in Their Contract With the City.

The friction between Mr. Andrew Hickenlooper and the successive electric light interests in Cincinnati has at times attracted a great deal of public attention. Mr. Hickenlooper at the time of the introduction of the electric light had a monopoly of the gas business in that city, and he has been from the first a hard fighter. Several electric light stations have been built, however, and one by one they have all come under Mr. Hickenlooper's control with the exception of the Edison Electric Light Company. He is now making open warfare against this latter company, and some months ago Mr. John I. Beggs was called to the management of the company in the hope that he could at least hold his own. Whether Mr. Beggs can succeed or not is still an open question.

The latest phase of the fight is interesting and goes to emphasize the necessity for an exact understanding of the meaning of words when a contract is to be signed.

The Edison Company claims that in platting the city the City Electrician has omitted hundreds of lamps which, under the contract, the Edison Company should receive pay for. The rental of these omitted lamps would reach nearly $100,000. A great many of the lamps are omitted at corners where small streets join thoroughfares. It is claimed by the company that these are street intersections, and that the contract requires a lamp at every street intersection.

The opinion of the Corporation Counsel is as follows:

"The specifications, which are a part of the contract, provide that: 'In the territory named as the First District, and over such contiguous territory as may thereafter be designated by the Board of Legislation, lamps shall be placed at all street intersections, where the squares measure less than 400 feet in length, unless otherwise ordered by the B. of A.; but where the square measures more than 400 feet in length, one lamp shall be placed at the street intersection and one at an intermediate point.'

"The corners to which the Edison Company calls attention are not street intersections. The streets do not cross one another. I take it that the ordinary interpretation of the word intersection is to cross, to cut into or between; and this view was taken by the Court in the case of the State vs. the New Haven and Northampton Company, 45 Conn., page 331. My information is that if the views advanced by the Edison Company were adopted lamps at some places would not be more than 60 or 70 feet apart. A careful reading of the specifications convinces me that it was the evident intent of the contracting parties that lamps should be 400 feet apart, and if a street intersected, that is, if one street crossed another and thereby formed a street intersection, and the distance thereby became less than 400 feet, then it was the intent that a lamp should be placed at the intersection; but it seems to me that it was never contemplated that where streets simply touch or come into contact with other streets that that was to be treated as a street intersection.

"For the reasons stated I therefore recommend that the application of the Cincinnati Edison Electric Company to place lamps at the various corners enumerated in their communication be rejected."

We think that Mr. Hickenlooper will have to put up a better job than this before he knocks out the Edison Company.

Elementary Theory of the Induction Alternating Motor.

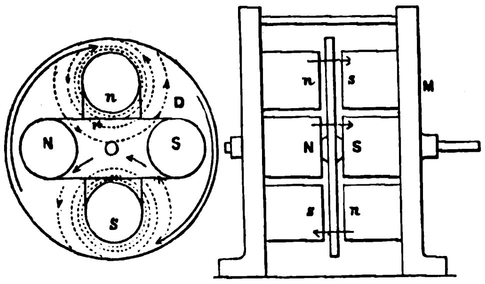
BY RANKIN KENNEDY.

II.

In the last paper I considered the elementary theory of the single-phase induction motor, and investigated the reason why it is not self-starting without some device being added to it for that purpose. We also found why it runs on when given a start. When stationary, the disk with its induced currents is in equilibrium, but if in motion, the paths of the current are carried round into a position where the magnetic flow propels the disk with its induced currents; we also saw how the lag in time between the current set up and the magnetic flow which set it up allowed time for the current to be carried round into a motor position in time to coincide with the following magnetic flow.

I now come to a class of motors in which we have two sets of poles and two currents, purposely made the one to lag behind the other by a quarter of a period, so that when the one is at its maximum strength the other is at its minimum or zero value.

By the use of two currents in this way we are able to make an induction motor start off from a state of rest with great torque. The induced current set up by the one set of poles is attracted and repelled by the magnetic flow of the other set, which being energized by a current coming a quarter of a period behind their magnetic flow, coincides with the current flow induced by the first set, so that the disk is propelled round to bring the current concentric with the second set.



FIGS. 3 AND 4.

In Figs. 3 and 4 this class of motor is illustrated diagrammatically. Imagine a copper disk mounted on a spindle and between two sets of field magnets, N, S, energized by one current, *n*, *s*, energized by the other; referring to Fig. 4, *n*, *s*, have just been energized by a wave of current which set up the induced currents in the disk, represented by the concentric dotted lines. The magnetic flow from *n*, *s*, is falling to zero; but the magnetic flow in N, S, is now rising to a maximum, and a time arrives at which the currents in the disk are a maximum, and the magnetic flow from N, S, is a maximum, while the flow in *n*, *s*, is zero, hence the disk is pulled round to bring the current flow concentric with N, S. Then N, S, set up an induced current in the disk, which in turn coincides with the next maximum magnetic flow from *n*, *s*; this propels the disk again to bring the current and magnets concentric.

Thus we see that the currents set up by the one set of poles are acted upon motively by the other set, because the one set of poles are at a maximum flow when the other set are at zero, and the currents induced by one set are at a maximum at the same instant that the magnetic flow of the other set is at a maximum, and thus the motor starts with considerable torque from a state of rest if we have two sets of poles energized by two currents having a difference of phase of one-quarter of a period.

Now, if after this motor has been started one of the two currents is entirely cut off, the disk will still run on, and, what is more surprising, it will exert as much power as it did with the two currents, or rather, to speak more accurately, it will run at a higher speed when at its maximum torque. This fact leads to a most important conclusion, namely, that the two currents are of no advantage except as an aid to starting; and if we could start the single-phase motor with full torque by any means it would have the advantage in simplicity and direct applicability to present circuits.

Mr. C. E. L. Brown has devised several methods of starting the single-phase motors described in our first paper, but what the actual torque obtained by the best of his methods is I cannot say, as actual independent tests are not available.

The shielded pole method described in our first paper is due to Prof. Elihu Thomson, and does not give more torque than that necessary for a start.

The two-phase motor has still the paramount advantage of starting without any extraordinary devices, and that, too, against considerable torque. And when it is taken into consideration that motors are only used to any extent in isolated plants, where the generator, the mains and everything else can be erected for two-phase working, the two-phase motor is likely to hold the field in cases where absolutely no commutation is desirable.

Immediately we introduce the commutator, even if only for starting purposes, then the motor is on a level with the ordinary continuous current motor; it is the entire absence of the commutator which is the sole recommendation for the alternating motor. Accept a commutator and the ordinary motor is ready to do the work.

It will be quite easy to apply this elementary theory to a three-phase motor; and at a future time we hope to describe actual disk motors of the types shown in these diagrams, which are to be taken merely as aids to understanding the principles and not the best designs for construction.

A COOL MILLION.

(From the Electrical Engineer, London.)

We thought that the palm for electrical fiction had been awarded to this journal on account of the wonderful adventures which befell Garnesdon some time ago (see the *Electrical Engineer* under date of May 11, 1894, and August 31, 1894), but pending the advent of Edison-and-collaborateur's novel, we feel obliged to confess that the New York *World* of August 26 last comes out easily ahead of ourselves and everybody else. This enterprising newspaper has a great genius who composes headlines, a greater one who writes column after column of elegant, high-sounding language, and the greatest of all in the person of Miss Meg Merrilies—a young and attractive lady with an ambition to rival Tesla and experience a million-volt current (number, or rather fraction, of milliamperes not stated, nor yet the periodicity, within 100,000 per second—but what do newspapers know of these things any way?). She did *it*, too, whatever the experience may be to take volts without amperes at any sort of frequency, and being a girl of scientific turn of mind, went and weighed herself on a slot machine before taking and after taking the dose. Weight —111 lbs.—remained the same, and the only ill effects, according to the young lady, which might have resulted were just that the "electricity would have stayed in her clothes for a time if the atmosphere had not been so humid." We wonder how many (or let us say, for the sake of credulous humanity, how few) of the ordinary public who read this elaborate effusion will take it at its proper value! As a first-rate "write-up" of Tesla's experiments, based on the plan of saying a thousand words where three single ones would do, and giving absolutely no information of any use to anybody, the *World's* startler is preeminently calculated to fulfil its main object—viz., to gull the public and extract some additional cents from the pockets of those who have no knowledge of electricity or its real marvels—greater than any Miss Meg Merrilies could write about.

Some Notes on the Governing of Steam Engines, Particularly When Coupled to Dynamos.*

BY G. L. ADDENBROOKE.

This is a subject which has always been in my mind in connection with central station electric lighting; and the fact that it has been brought into prominence by Mr. Swinburne, in his simple but lucid paper before the British Association, shows that the question is now beginning to attract the attention which it deserves.

In order to understand the exact position of matters at present, as regards the governing of the engines used for other than marine purposes, it is advisable to look back a little at the history of the steam engine governor, and the purposes to which it has been chiefly applied up to the present date, premising the fact that so far electrical engineers have not paid any very great amount of attention to the problem, as they have been occupied by other considerations of more immediate importance, and have been generally content in this particular to accept the practice of industrial engineers, and to rely on their judgment as having the greater experience.

What really caused careful attention to be paid to the construction of governors and valve-gear was the application of steam engines to driving spinning machinery, the rise of mechanical weaving and spinning and the best modern type of steam engines being almost contemporaneous. For a loom to work properly regular speed is essential, or the shuttles will not throw properly and uneven strains are produced in the material. Not only, therefore, has the best steam practice been usually devoted to the construction of engines for driving textile factories for the sake of economical working, but at the same time the utmost pains have been taken to design valve and governing gear which would admit of the engine doing its work at a constant speed whatever the load. The latter condition was essential, because one engine was only employed for driving at a time, though the load would constantly vary as different machines were thrown in and out; and at times a part of the factory might be altogether closed if work in one of the departments was slack.

The engineers who devote themselves chiefly to the construction of mill engines have for many years been able to meet these conditions and to supply plant which would readily retain a speed within 2 per cent. or 3 per cent. of the normal, whatever might be the load. It is true that large fly-wheels and comparatively slow speeds have hitherto been chiefly in vogue for this class of plant but this is a somewhat minor point.

Such being the state of affairs when electric lighting first became practical, electrical engineers naturally turned to the constructors of mill engines for advice and help; the result was the application of the mill engine, with rope driving, to turning dynamos, a system which has worked well wherever it has been applied, while for freedom from breakdowns and exactness of working this method has probably not yet been surpassed. Such plants, however, occupy a great deal of space, are rather expensive, and there is a certain loss of power in rope driving. Consequently the high-speed engine has been developed to get over these difficulties, so far, chiefly of the single-acting type; but now that the conditions of running of such engines is better understood, and confidence in high speeds is increasing, there are indications that similar engines, but double-acting, will gradually come to be preferred.

Our cursory glance at the history of the application of governors to engines has now made it manifest that the best practice hitherto has been in the construction of governors to produce perfectly even motion whatever the load. Further, it must be noted that such engines have usually been engaged in supplying energy direct in the form of motion to lines of shafting and to machinery which it is required to run at a constant speed.

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* Abstract from the London *Electrician*.

Let us now turn to the driving of dynamos by means of steam engines. The proper methods of governing such engines will naturally depend on the purposes to which the current produced is to be applied. If for the transmission of power or the running of arc lights in series, very little alteration of existing methods is required; but if the engine is used for lighting incandescent lamps direct, whether for a private installation or in a public supply station—which latter is, of course, the most important case, and the one to which it is proposed to devote most attention—then it is desirable to clearly define the limiting conditions of the problem; so that, knowing exactly what is required, we may be in a position to judge how far existing appliances meet the conditions and where they are defective, and thus arrive at a definite idea of the directions in which alterations and improvements are required.

Now in a central station the ultimate object is the incandescing to a certain point of carbon filaments, to procure from which the standard amount of light—16 candles from a 16 C. P. lamp—the pressure or voltage must be steady and exact, within one per cent. on either side of the normal, any further variation either way making a great difference in the light.

Perhaps, in order that we may present to ourselves a clear idea of the conditions, an entirely mechanical analogue may be useful. Let us suppose that the engine room in a central station is the engine room of a large mill which is worked by several steam engines, driving by means of pulleys and friction clutches on to a line of counter shafting. Imagine that these clutches are not very well designed, and that there is always a certain amount of slip in them, not more than 6 or 7 per cent. at light loads, but increasing considerably at heavy loads. It is, of course, required to keep the mill machinery running evenly within 2 or 3 per cent. If the load is a light one not only will the engine or engines be lightly loaded but there will be very little slip in the clutches; on the other hand, as the work done in the mill increases and becomes heavy, not only will the load on the engines increase, but, having to keep the mill machinery revolving at a constant speed, the speed of the engines will also have to be increased to make up for the extra motion lost in the clutches, the friction of which will absorb energy, which will be dissipated as heat as the losses in dynamos are. Under these circumstances it is clear that it will not be sufficient if we have a governor which keeps the engines running always at the same rate; we must over-govern to some extent, that is, we must not only have the speed of the engine always under control, but we must also have an arrangement by which the engine shall go a certain percentage faster at heavy loads than at light. We may diminish the difference of slip at different loads by improving the efficiency of our friction clutches, but the fact remains that it exists to some extent and that it must be compensated for.

In an electric lighting central station the dynamos may be regarded as the friction clutches in the above simile. Besides a certain loss of power greater at heavy loads than at light, and which may be likened to the loss in friction in the clutches, there is also a loss of motion, increasing with the load, due to self-induction and the back action of the armature current on the fields, which weakens them and necessitates the speed being increased to obtain the same voltage; this is like the slip in the friction clutch. If not corrected by outside influences it may amount to from 10 to 20 per cent.

In the central station there is the further point that at the hours of heavy load it is necessary to run at a higher speed altogether than at light loads in order to keep up a higher general pressure in the mains to allow for increased loss in them.

Consequently, in driving dynamos in central stations for lighting, we have not only to secure regular running or absence of sudden variations of speed at all loads, but we have got to provide, taking the light load as a basis, that as the load increases the driving speed shall be increased in order—

1. To increase the pressure on the mains.
2. To overcome the increased armature resistance and provide increased excitation of the field magnets.
3. To make up for the slip or loss in pressure caused by the increased back action of the armature on the magnets and increased self-induction, which necessitates a higher rate of driving, though it does not directly mean loss of energy.

It is true that it is not absolutely necessary to increase the speed of the engines; it may be kept constant at all loads as in mill engines, and the requisite variations may be produced by the use of resistances or by varying the excitation of the dynamos, by means of resistances or the use of a separate exciting engine.

The Electric Brake in Practice.*—II.

BY ELMER A. SPERRY.

Table II was obtained as shown in Fig. 3. A brake shoe that had been run in service about three or four days was taken with the axle carrying its co-operating wheel, lifted out of the truck and placed between the centers of a lathe, the load upon the brake shoe accurately measured, and the shoe held from movement around the wheel by a dynamometer. Every precaution was taken to avoid handling the periphery of the wheel or the face of the brake shoe, and even the dust was left upon it so as to conform as nearly as possible to the normal conditions of practice.

Table II.

Speed rev. per minute 33 in. wheel.	Brake pressure.	Traction.	Coefficient.
Varying, 150	900 lbs.	87.4 lb.	9.7 per cent.
125	900	91.7	10.2
100	900	99.8	11.1
78	900	118.	13.2
56	900	133.	14.8
38	900	150.4	16.6
20	900	154.	17.1
4	900	174.6	19.4
Constant, 105	300	29.4	9 8
	500	50.5	10.1
	750	91.	12.
100	1,150	125.	11.2
	1,500	178.	12.
	2,200	305.	14.4
94	3,780	488.	13.2

Tracing our 180 lbs. application to the brake beam with allowance for loss by friction, we have 3,840 lbs. applied to each of the two shoes, which upon the chilled surfaces are found under ordinary circumstances by Table II to give a coefficient of about 12 per cent. This would give a retarding effect of 460 lbs., which is less than one-third that easily obtainable were the power needful for its application at hand. The coefficient under these conditions must have been about 37 per cent. to realize anything like the total value of the retarding effect of the wheel. This under condition of chilled and glazed surface is entirely out of the question, showing at once the necessity of power in the application of brakes, if anything like their full value and use is to be obtained. This is also amply borne out in practice, as those who have tested this point well know that under ordinary conditions it is next to impossible to slip the wheels of a motor car by the hand brake.

In the electric brake, on the other hand, the fact that the truck parts are not bound up and locked into a solid mass by the enormous pressures of the heavy brake levers and shoes is found to prevent racking and straining the truck as well as jumping the track and curves when the brakes are set. The axles and truck parts are perfectly free for easy and normal movement even when the brake is exerting its full power. Great reduction of wear at the pedestal journals is also found, owing to entire absence of all the usual heavy pressures of the brake shoes. We can all see that by applying adequate power and control to the wheel brake, this element of the equipment may be raised to the position of an indispensable safeguard, the value of which can only be appreciated as its hitherto undeveloped resources are brought out, demonstrated and rendered simple and easy of application and control. In practice the greatest necessity for maximum brake application exists at the higher speeds. From Table II it will be noticed that at just this point the failure is greatest, the coefficients being least, increasing as the speeds decrease. This has always constituted the one grave fault of the air brake in railway service. The intensity of its application should be greatest when the speed is greatest, and decrease as the speed drops off. As will be shown farther on, this point has been fully covered in the electric brake, which is the first time that the varying application has ever been embodied in practice, and especially in such a manner as to perform its important function automatically.

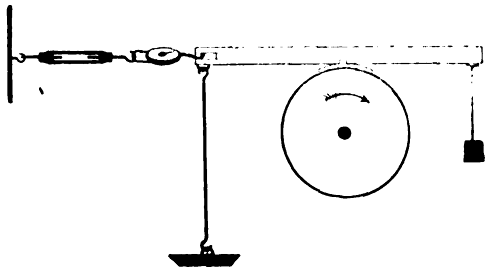
Fig. 3.

A plan, especially one pertaining to electrical matters, after having been proven mathematically to be feasible, is far from being realized. Many are the practical difficulties to be surmounted before a thoroughly commercial or anything like a standard apparatus has been produced. Especially is this true in the electrical field. Many subtle influences and energies are at work which well nigh overwhelm the experimenter. In a new field but few precedents are at hand, and these are apt to be extremely unreliable and in the nature of a blind leader of the blind. The practical application of the electric brake, although probably no exception to the general rule, amply illustrates the wide distance to be spanned between the conception of the idea and the commercial apparatus itself. For years the writer has believed that electricity was vastly preferable to any other force for the application and control of brakes. Working first on the solution of the continuous brake problem for railway trains, he built his first electric brake apparatus in '82 and has studied and experimented on the problem in its various phases almost continuously since that date, with more or less encouragement in the line of substantial progress. As to its application to electric cars, the apparatus was successfully applied on some double truck cars in Illinois, one of these cars weighing as much as twelve tons. The first equipment embodying this apparatus was constructed some five years since. The apparatus has been constantly undergoing alterations and been experimented with, until for the past eighteen months a constantly increasing number of electric cars, equipped with it, have been in regular service, some of these running with change of motormen on each of thirteen daily trips, the same motorman having the car once in about three days, making it impossible for the men to become familiar with the operation of the brake. During this time one car has made upwards of 70,000 miles, hauling a trailer about 48,000 miles, during some special weeks of test making from 178 to 220 miles daily.

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* Abstract of paper read at the 89th Meeting of the American Institute of Electrical Engineers.

At the mention of electric brakes the engineer at once admits that they should be entirely feasible, and usually adds that there is plenty of electrical energy at hand from the central station to retard and control as well as to propel the car. This, however, is not the method undertaken by the writer. To employ the central station current for operating the brakes would be to limit very materially their usefulness and certainty of operation. The braking current, although used at comparatively infrequent intervals, and then only for a short period, should for this reason be absolutely certain and unfailing in its action, and not subject to any "heart failure" of the central station, or sudden cessation caused by the opening of the circuit breakers, the interruption of the line, the flying off of the trolley, failure of the fuse, or failure at other more or less vulnerable points. The electric brake under discussion has been operated over a year on equipment upon different roads, from electricity generated independently of the trolley connection, the braking current not being derived from the central station but produced by the power of the moving car, which power it is desired to get rid of or destroy. The brake thus operates equally well with the trolley off, and, as will be understood from the following description, the trolley current has nothing at all to do with the car while the brake is being operated, except possibly to maintain the light circuit. The electric brake at the same time is entirely independent of the hand brakes, which may or may not be present upon the equipment. The current employed by the writer for operating the brakes is developed by automatically turning the motor or motors into generators. As these are driven forward by the moving car they develop current which is controlled as to intensity by the starting rheostat of the car. The braking current is thus produced at the expense of the mechanical energy stored up in the moving car, which being consumed causes a retardation and final stopping of the mass as a whole. The current so generated may be furthermore led through a brake magnet, as above seen, to apply the brake shoes; it may arrest the motion of the car direct by magnetic adhesion, or develop heavy retarding currents in the moving metallic mass by magneto-induction. When an active local circuit is used, the latter method is usually employed for reasons which will be made more apparent.

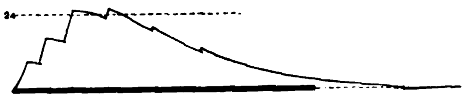


FIG. 4.

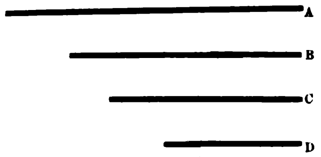


FIG. 5.

In developing this system, the point which seemed fraught with the most difficulty, and which has finally received the simplest solution of any in connection with the problem, was that of obtaining always and with absolute certainty sufficient current at the lowest speeds without the aid of the trolley current. Teaser coils were at intervals resorted to, maintaining connection with the trolley circuit. "Artificial teasers" were also used, being a device by means of which the trolley circuit was entirely done away with and which worked well. Observations made from time to time in connection with these experiments led to an exhaustive investigation of residual magnetism, in consequence of which structural means were adopted to utilize to the full the residual magnetism of the motor. This supply is constantly being renewed with every energizing of the car. This method was found to be the simplest as well as the most effective. The connections, and in fact the whole arrangement of the electric brake upon the car, is extremely simple. This is shown by the fact that only one small extra wire needs to be run to the controller in addition to the ordinary wiring of the standard equipment without the electric brake. The certainty of operation is evinced by the fact that at present writing over 150 of the equipments have been placed, which are making upwards of 10,000 miles daily in regular service. Early in the experimentation a phenomenon was observed in reference to the persistence of the current even after the motor had stopped. This is due to the slow action of the decreasing magnetization, taken together with the reaction or self-induction effect of the fields and any brake coil or coils that may be in the circuit. The movement of the magnetic lines, which persist after, and in fact long after the motion of the motor had ceased, generates potential. In many instances it is possible to draw an arc from the rupture of the brake circuit one second after the motion has ceased, showing the presence of current in the local circuit.

Fig. 4 has been developed from the average stop to show the curve of current in reference to the motion, the black lines indicating the period of motion during the application of the brake, and the curve indicating the current intensity and its duration. The current flowing after motion ceases, though small, is found exceedingly useful in holding the car from starting itself, even on quite a heavy grade, as only a small quantity of energy added to the already great friction of quiescence will prevent the car from starting. This persistency of current is also found useful to kill or destroy the magnetism of the brake magnet in case it is desired to suddenly move the car forward again. The tendency on the part of the windings at the moment of rupture to generate an opposing E. M. F., tends to suddenly free the magnet from its face, a purely accidental feature which is of great value and utility in this connection. The wonderful energy of the withdrawal of the lines of force, being in its manifestations a phenomenon of magnetic viscosity, is illustrated by the following fact: With a perfectly dry track, a great force is required to shear the adhesion and start the wheels slipping. A car going down a grade under these conditions where no brake magnets are present will, with a sudden application of the electric brake, generate sufficient current to not only arrest the motion of the wheels, but start them going in the opposite direction, the reverse motion being maintained through an interval truly remarkable, in some instances running as one and one-half seconds. It will be borne in mind that all the above phenomena are entirely independent of the central station current, the trolley connection having been severed before the brake is applied.

The current required to be developed to stop a car when no other braking apparatus is used is found to be only a fraction of that required to accelerate the car in the same interval. This may be easily illustrated by the lines in diagram Fig. 5. A being the electrical energy applied in a given acceleration; B the resulting mechanical energy stored in the car after deducting all the wastes in the motor and between the motor and the momentum; C the average mechanical energy in the car at the time of applying the brake; D being the electrical energy required to be developed for retardation after the efficiency losses have all been provided for out of the quantity C. Thus it will be seen that the so-called efficiency losses act in a two-fold sense, between A and B and between C and D, to reduce the amount of current required to be generated for braking purposes.

As to the effect of the electric brake on the total temperature of the motor the following experiments were made. A car and trailer were operated over the line in regular service 41.1 miles without the brake. The temperature of the atmosphere was noted every half hour during the test, and the temperature carefully taken of all parts of the motor at the end of the run.

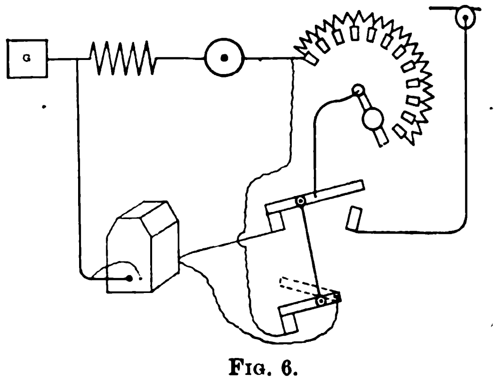


FIG. 6.

The succeeding day a similar run was made with the same trailer over the same track and in the same length of time, but with the electric brake in use, braking direct on the simple local circuit without brake magnets. The difference in the average atmospheric temperatures during the two days was six and one-half degrees, and the difference in the average temperature of the motor parts was seven degrees, making only a difference of one-half of one degree centigrade as the total increase of temperature from the use of the brake. Observations in reference to the heat in the rheostat were made, although no temperatures were taken, and no difference could be observed in reference to the heating of this portion of the equipment. The explanation will be found in the comparatively small amount of current as seen above, and the relative infrequency of its application and short duration at the time of each application. The following wattmeter readings have also been taken:

	1st Trip.	2d Trip Trailer.
Reading of wattmeter, leaving Lake View	392,538.9	392,542.25
Reading of wattmeter, end of round trip	392,542.25	392,547.1
Number of full stops	55	53
Number of slow-ups	42	37
Time	1:40	1:35
Difference in reading	3.35	4.85

Constant of wattmeter equals "22"; total watts both trips, 180.4.

Diagram No. 6 indicates the connection of the wattmeter in the circuit.

Automatic resistances were even at one time used in the endeavor to relieve the motorman of *all* responsibility in connection with the control in applying the brake, but superlative simplicity was found to be much more desirable than the superlatively automatic, and the automatic devices were seen to be entirely unnecessary, the apparatus as at present constructed being of great simplicity.

The diagram of the braking current in Fig. 4 shows the automatic decrease in the intensity of the brake application so desirable with the decreasing speed referred to above. As the speed decreases the generator runs more slowly and consequently produces less and less current.

With this style of brake, the life of the wheels is increased from two to three fold, thus affording a saving in the item next in cost to the electric maintenance itself, to say nothing of the entire saving in brake shoes. This is emphasized in the fact that the brake shoes are being constantly besmeared with sand and grit thrown from the wheels, and when in this condition they are brought against the wheels with the tremendous pressures noted above. A better method could hardly be devised for reducing both wheel and shoe. We little realize the great number of brake applications necessary in a day's run. Careful record has been kept of this point, giving in three days an average of 1,377 brake applications per day for a run of about 164 miles.

Another interesting feature in this connection is that a flat wheel from skidding is an impossibility. It will readily be seen that should the wheels stop, the generator connected with the axles ceases to produce current, and none therefore exists to further apply the brake, and though they may be sliding forward on the rail, yet the wheels continue to rotate more or less and constantly present new surfaces for the sliding contact.

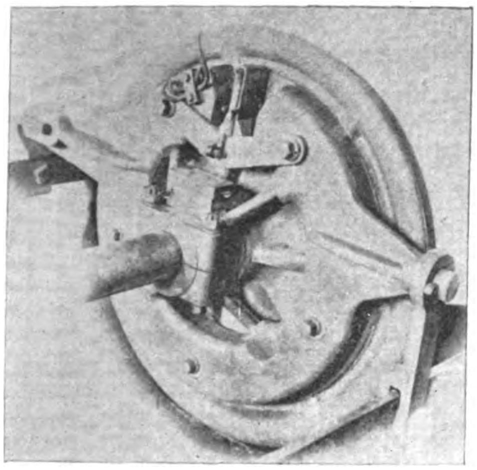


FIG. 7.

The braking action is two-fold and is especially efficient. The rotating armature of the motor, instead of tugging ahead by its momentum, is itself pulling back and more or less powerfully braking the car through the gears by the retarding effort of the magnetism of its field while generating the braking current. The power required therefore to perform this work is taken from energy of the moving car which it is desired to destroy; not only is the car thus retarded, but the electric brakes arrest the motion of the wheels direct with a force that is remarkably powerful and under perfect control of the motorman.

Two forms of braking magnets are used, one for winding up a brake chain usually employed in connection with the trailer, and another for directly arresting the motion of the axles, as shown in Figs. 7 and 8. These magnets are truckmounted, not an ounce of their weight being directly on the axle, and are so supported that their gravity acts to automatically retract them from the brake face (see Fig. 10), the latter showing the link standing out of the vertical. The brake face is automatically lubricated to a slight degree, receives a high polish and does not cut or rapidly wear. The brake is noiseless in its operation.

It will be seen from the cuts that inasmuch as it does not revolve, no commutating or contact device is necessary. Its crescent form accomplishes important technical functions and also eliminates the necessity of pulling off a wheel for its attachment, removal or inspection. Its face is *solid unbroken metal* with no grooves or interstices for catching grit or sand, which in part explains the absence of wear above referred to. The brake magnet is practically indestructible, a few turns of stout wire constituting its one coil entirely enclosed and sealed in metal. No harm nor moisture can reach it. As to moisture, it is immaterial, as the E.M.F. at which it works is extremely small, seldom reaching six volts. The lubricator for the brake surface is dry, not sticky or adhesive, and does not gather sand or dirt and retain it on the braking face. No mechanical pressures whatever are employed to arrest the car, and hence no strain or shoulder-wear comes upon the journals. In constructing the brake magnets their proportions and the arrangement of the magnetic circuits received considerable study. It was during some preliminary experiments that an unexpected phenomenon was noticed; namely, that the retarding effect when speed is an element is very much more than would have been expected from the coefficient of friction due to magnetic attraction or adhesion, this latter being a known and definite quantity. Further experiment, made to ascertain the cause, showed it to be due to Foucault or eddy currents set up in the masses. The conditions and structure of the brake magnet were therefore varied in a number of particulars, especially such as would be expected to give the greatest result in Foucault currents produced. The result was immediately successful. It was found that the retarding effect of the brake magnet is due very much more to the generation of these currents than to the direct effect of the coefficient of friction resulting from direct magnetic adhesion, the amount of which I find can be relied on accurately when employed by itself. Some of the forms of brake magnets experimented with were provided with numerous poles of opposite polarity, which were worked upon three different kinds of armature, two of which had radial teeth of different number relative to those in the magnet, and one being a plain disk armature. The toothed armature, while it causes a series of sudden jerks and is also unsatisfactory in the total retardation resulting from a given input is found also upon rupture of the magnetic circuit to impart to the magnet coil certain counter E. M. F.'s which materially cut down the current supply and thus the capacity of the device. A magnet formed of a continuous disk with an annular groove sunk in its face is found to give very satisfactory results, but is much heavier and requires an armature twice as heavy for a given number of lines as the double circuit magnet shown in the figures. Furthermore, the relative rotation between such a magnet and its armature affords no point in the masses where the lines are interrupted or changed, and the Foucault currents or reactionary effect set up is very much inferior to those in a magnet where a gap or cessation of magnetic stress is continuously produced. As a result of these investigations the crescent form shown in the figures has been adopted, the opening in the crescent giving the effect referred to as well as affording an excellent method of attachment and removal of the brake magnet and at the same time supplying a gap for easily reaching the face for inspection and lubrication. A lubricator (see Figs. 7 and 8) is shown as occupying this space. The belief that the extra retarding phenomenon is that of Foucault or other eddy currents is borne out by the fact that a conducting lubricant such as graphite is found to considerably increase the effect, also metal filling between the polar faces is almost indispensable for the best result while at the same time effectually protecting the coil from all damage. These observations would seem to indicate that the eddy currents, however produced, circulate in both masses near the surface, and traverse back and forth across the air-gap whenever ample provision is made to allow them so to do. The practical value of the combined action of all these forces in increasing the retarding effect, results in necessitating but a small magnet, and a smaller current expenditure considering the work performed

By reference to Table III, the result in retardation gained through the eddy or other currents may be plainly seen, column A indicating the retarding effect which should be expected from a friction coefficient of 10 per cent. between the lubricated surfaces due to magnetic attraction of the lines actually circulating, and column B indicating the values of retardation actually obtained on the dynamometer.

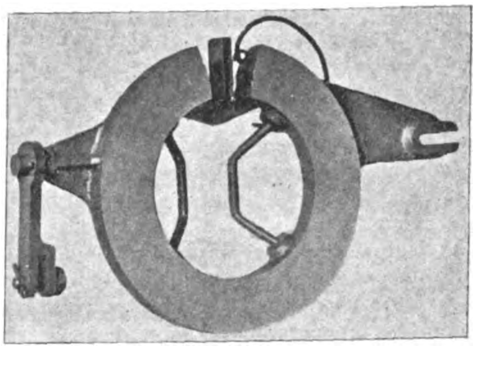


FIG. 8.

That the important positions and trying circumstances under which the motorman often labors are appreciated, may be seen by the space devoted to it in the daily press.

TABLE III.

Amperes.	Volts.	"A" Pull due to magnetic adhesion or traction. Friction coefficient 10 per cent.	"B" Pull on brake chain obtained. Graphite lubrication.
5	1	7.6 lbs.	125 lbs.
9	1.8	18.3	300
9.5	1.9	36.4	608
15	3	121.	1,976
16	3.2	149.	2,432
20	4	158.4	2.584
23	4.6	167.	2,786
25	5	186.	3,010
31	6.2	207.	3,385
35	7	213.	3,490
35.5	7.3	214.	3,500
41	8.5	223.	3,650

The assumed values are based on a traction of 28.26 lbs. per square inch for 45,000 lines per square inch, being the assumed values at the knee of the curve easily recognized as occurring between 16 and 20 amperes in the table.

As to the arrangement for application and control of the brake by the motorman, about a year ago the following appeared from the pen of the author:

"Considering the inexperience of the operator and the responsibility which at times well nigh overwhelms him, I think that, as engineers, we should be willing to set a very high mark to be attained in the ideal brake for electric street railway service, namely, the use of but a *single*

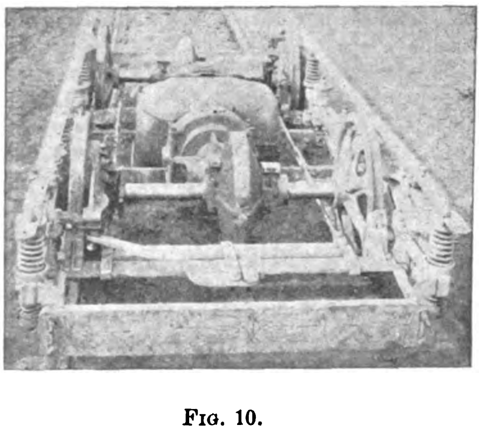


FIG. 10.

controlling handle for everything; starting, accelerating, retarding and braking the trailer or trailers and all. Let the motorman have nothing to think of except one handle, and two-thirds of the accidents now occurring will be prevented. Let this handle require no more exertion in its operation than the present controlling handle. Let the motorman fulfil his function with as little physical exertion as possible; he will then have a greater reserve for mental application when necessary. A motorman required to exert an enormous amount of brute force, constantly grinding at the brake, has but little life left to apply in case of emergency. I agree with a prominent writer on this subject, where he says that a multiplicity of handles is fatal in time of emergency."

At the time the above was written, equipments controlled as therein set forth, namely, by the use of a *single controlling handle for everything,* had been in operation for upwards of a year. The methods employed for accomplishing this have been varied, but the form most in use at the present time is the one in which the resistance contacts are employed in a twofold manner; the controller handle is made to operate back and forth over the same contacts for controlling both the application of the current to the motor and braking the car. A self-correcting and interlocking device is also provided, and therefore if the motorman does not throw the handle clear over, the transformation is completed automatically before the movement of the lever can reach the operating contacts.

(*To be continued.*)

Continuous or Alternating Arc Lamps.

From a user's point of view, the continuous current arc lamp is in many ways to be preferred to the alternating lamp. It is silent, its light is thrown downwards, it burns cheaper carbons, and, above all, the troublesome question of "frequency" has not to be reckoned with. A continuous current lamp can also be purchased from any maker, and it can be placed on any continuous current circuit. With alternating arcs, however, it is necessary that they should be wound for the frequency of the particular circuit for which they are required. It is marvellous that electrical engineers should have perpetuated the insane practice of using so many different "frequencies." It is unquestionably detrimental to the advance of the alternating arc lamp business. We have always held that the frequency should be fixed at something about 60°; it should never on public supplies exceed 65, or be less than 50. If such a uniformity were made compulsory, the benefit both to arc lamp makers and users would be enormous. It would at the same time give an immense impetus to the alternating motor business.

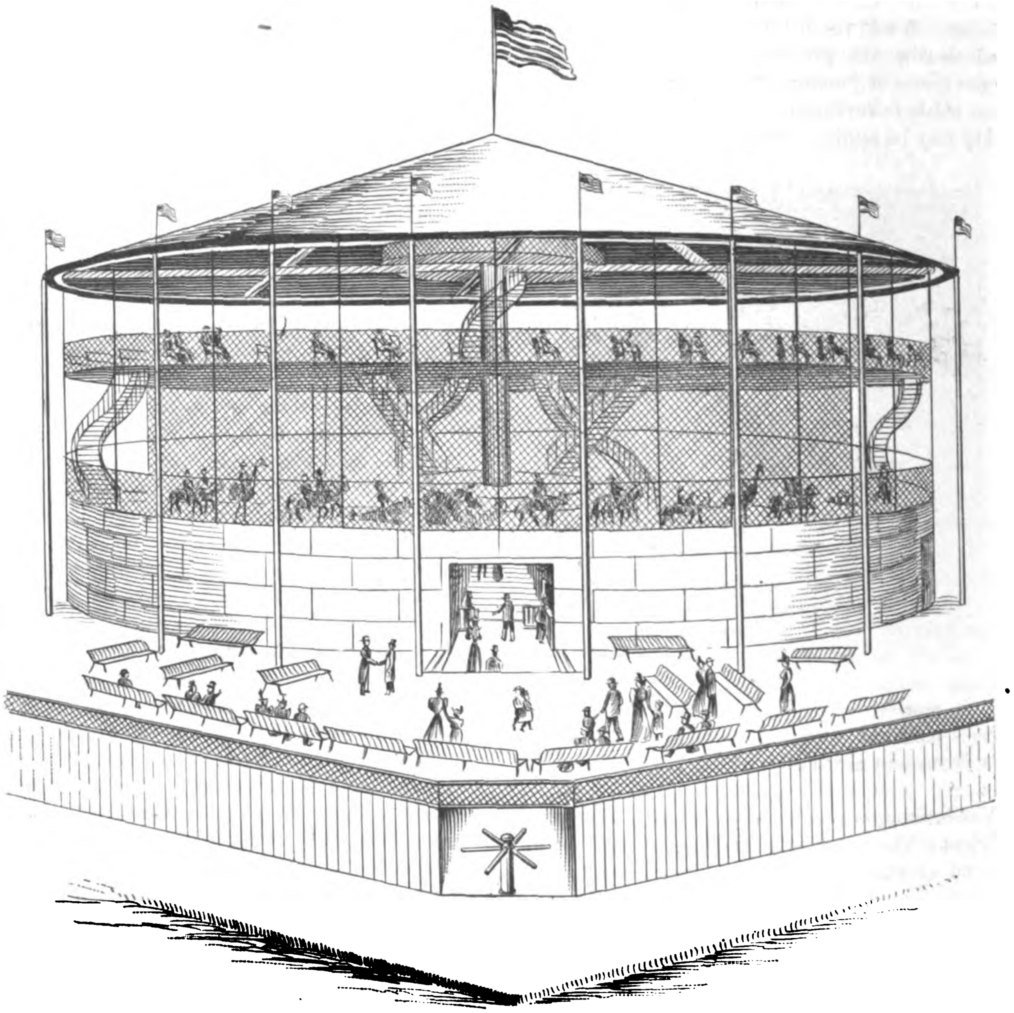
Those who use arc lamps have, generally speaking, little choice in the matter of selection. By the wise dispensation of the electrical providence, it is ordained that they shall be supplied with a certain kind of current; and so, in selecting an arc lamp, it is often a case of "Hobson's choice." Arc lamps would be much cheaper and much more extensively used if only one kind of current were supplied for arc lamps, and that continuous; as matters stand the best that can be done is to reduce the number of different currents to two, continuous and alternating, and not go on with half-a-dozen different alternating currents, each requiring specially wound lamps.

Where a large number of arc lamps are used, it would pay to employ a rectifying commutator and run the lamps with the unidirection pulsating current, but where only half-a-dozen arc lamps are used it would be too expensive and troublesome to use such a commutating device. The electricity supply of the future will be one that will give either alternating or continuous current, according to the desire of the consumer. When this electrical millennium arrives, we have no hesitation in predicting that the alternating arc lamp will be crowded out by its rival.

We know of a case where a user of arc lamps has a warehouse situated in an alternating current district and another warehouse in a continuous current district. The difference in the light, the absence of noise and the economy in current are all largely in favor of the continuous current.

From the manufacturer's point of view, the only difficulty is the necessity for making different kinds of lamps where one common kind might suffice. As things are, he has to wind lamps for all the different currents and different frequencies from 40 to 133 per second, and with his motors he is confronted with the same stupid difficulty. For photographic purposes the continuous current arc is much superior, and in searchlight projectors it is far better than the alternating, the crater formed on the positive carbon being of great advantage in both these cases.

The moral of all this seems to be that we are face to face with a "long felt want," in the shape of a cheap and efficient means of transforming from alternating to continuous current.—*Electrical Review, London.*



An Electric Carrousel.

An Electric Carrousel.

The electric motor has recently found application on a "merry-go-round," and the "Electric Carrousel" is now in daily operation in the city of Pittsburg, to the great delight of a multitude of children as well as young people who enjoy a ride on the wooden animals.

The idea was originated and patented about six months ago by Mr. G. W. McKenzie, who soon after organized a company under the name of the McKenzie Electric Pavilion Company. The next thing was to find a suitable place to put up the plant and operate it profitably. This site has been found at the corner of Fifth avenue and Smithfield street, Pittsburg, the place where the old postoffice used to stand. Ground was broken on the structure on August 6 and on September 5 it was started for the first time, proving a success with the initial revolution of the wheels. Since then thousands of people have been riding daily, and it appears that the popularity of the electric "merry-go-round" is growing greater every week.

The structure is very much after the style of the ordinary carrousel, but it has three revolving stories. For appearance's sake the structure proper is elevated. The first story is divided into two separate parts, a moving and a stationary one. The second story and the third—the latter is intended for the band only—also move. All the floors are built upon iron girders, which extend from a large iron axle in the center.

The outer platform of the first floor is practically a succession of 32 trucks running on a 6-foot curved T rail track. Four of these 32 trucks at regular intervals are equipped with a 15 H. P. Westinghouse railway motor. These motors cause the whole structure, axle and all, to revolve. The first floor is fitted up with animals, such as are seen in the ordinary "merry-go-round." There is also a restaurant attachment as well as a pavilion—in fact the idea is very unique and ingenious. Electric lights are used to light up the structure. The operation of the motors is attended to from a little building close at hand, which is fitted up with a controller switchboard with appliances.

Mr. C. M. Clark, a mechanical engineer of this city, has attended to the mechanical part of the structure. This novel "merry-go-round" has attracted a great deal of attention in Pittsburg and its operation promises to be very successful.

On Multiple Series Control of Motors on Small Electric Railways.*

BY JOHN LANGTON.

The only efficient method of controlling electric street cars is to vary the volts at the motors according to the speed required. The facility for doing this with storage batteries, by means of grouping the batteries differently, is one of the strong points of battery traction. In a trolley or conduit system with constant line pressure the same thing is arrived at by grouping the motors in series or in multiple. With only two motors to deal with, as in an ordinary street car, this makes rather an abrupt stop, which is eased off to a more gradual change by slowing them down by a resistance in series, or speeding them up by cutting out part of the field winding or shunting it by a resistance. This method was used in the early days of electric railroads, but was abandoned, not because it failed to give the results expected, but because it introduced a new complication at a time when there were so many troubles with everything that simplification was the pressing need. These early difficulties having been surmounted, multiple series control has been successfully revived.

The figure usually accepted for traction on street railway tracks in average condition, is 30 lbs. pull on the drawbar per ton weight of car, moving on a straight and level track. To start the car from rest requires a much greater effort. Dynamometer experiments show a starting pull of from 90 lbs. to 120 lbs. per ton, equal to the traction needed for ascending grades of 3 per cent to 4½ per cent.

When the car is started with the motors in parallel, controlled by the simple process of masting in a rheostat the volts that are not needed at the motor terminals to give the amperes required for the traction, the demand on the station for power is greater when the car is being started than at any other time of its run, except on roads with heavy grades. But putting the motors in series for starting greatly reduces the power required. The torque of the armature, which gives the traction, is a matter of amperes, and with the motors in series the same traction is obtained with one-half the current required when the motors are in parallel. The power consumption from start to full speed is rather more than one-half, apparently because the accelerating force is more irregularly applied, so that it takes longer to get up speed; or to put the same thing another way, in order to get up to speed in the same time, rather more than half the average amperes are needed for motors in series as compared with motors in parallel. The actual figures seem to be about two-thirds the maximum power and two-thirds the total power consumption in starting and getting up to speed in the same length of time. This method of starting then takes a maximum current, which if divided between the motors in parallel would only give the traction needed for ascending grades of from 1 per cent. to 2 per cent., and as almost every road has steeper grades than these, the heaviest power demand on the station comes, not from starting, but from moving up grade at full speed. But if we are content to go up such grades at a considerably reduced speed, we can get, as in starting, the necessary traction with half the amperes by putting the motors in series. The motors are then working with good efficiency on half the line volts and running at about half speed. There is of course no saving in the total power consumption--the energy; the car takes half as much current, but also takes twice the time to cover the distance. But there is a great reduction in the maximum power required, which would be about the same on a 5 per cent. grade with motors in series as on a 2 per cent. grade with motors in parallel, or about the same as the maximum power required for starting with motors in series. The motors must carry the same current in either case and must therefore be the same size, but the maximum demand on the power station from any one car is reduced nearly one half.

On large roads the principle of averages may be relied on to a great extent, and the station capacity per car may approximate the average power taken by the car, but on small roads it is in general safe only to provide a station capacity per car of very near the maximum car demand. On small roads, therefore, a reduction of the latter means a reduction in size of station plant. Even if the average demand on a large station were appreciably affected by multiple series control it could hardly be availed of. The most valuable reduction is that on grades, which may last for some minutes, whilst starting is a matter of a few seconds. But rapid transit is a principal reason of the existence of large electric roads and a prominent source of their income, and they cannot afford to go slowly up hill. For large roads the principal value of multiple series control is the ability to run slowly with good efficiency in crowded streets, and the saving of wear and tear on switch and rheostat at such times and at starting. On small roads with a few cars running on fifteen to twenty minutes headway it is more a question of communication than of continuously rapid transit; and, as has been shown, by sacrificing speed up hill a substantial reduction in the first cost of power plant may be achieved without any sacrifice of ability to run at high speed on the level and low grades. The horse-power hours drawn from the station would be the same per car trip in either case, but by easing off the starting current and slowing up on grades the power would be drawn more uniformly, with the tendency to reduce the variations of load on the steam engines. This should give better economy in steam consumption, but it is not at all probable that there would be any noticeable effect on the coal bill. The load diagram of the station would still be badly serrated but the peaks of the diagram would be of more uniform height, and the highest of them lower than with motors always in parallel.

There is nothing new in this paper, and the facts and conclusions seem fairly obvious, but these and similar simple engineering considerations are continually either not observed or not appreciated in projected works, with the result of paying an extravagant price for some quality which brings in an inadequate or no return.

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*Paper read at the Montreal meeting of the Canadian Electrical Association.

Novel Trolley Accident.

A novel accident occurred on a trolley line in Baltimore a few days ago. A number of men were digging in Washington street to discover a leak in the gas mains. One of them, Michael Costa, was at work in an excavation between the car tracks of the De Kalb avenue line. He had dug a hole about three feet deep, but there was so much escaping gas that, instead of crouching down and permitting an approaching car to pass over him, as he had done with other cars, he sprang out and stepped to one side. As the car passed over the hole the electric sparks in the motor set fire to the gas, and a sheet of flame blazed up on either side of the car with a loud report. The explosion shook the car and frightened the passengers, many of whom jumped recklessly off the car. It passed safely over the burning gas and no one was hurt. When the car stopped the passengers resumed their seats. The flames rose to the height of ten or twelve feet, and could not be extinguished until the gas was turned off, although sand was heaped upon the main and water poured in the excavation.

LEGAL NOTES.

A bill in equity was filed in the United States Circuit Court at Pittsburg on the 27th ult., by John E. Ridall against the McKeesport Light Company and the Brush Electric Company. Ridall states that he has the exclusive agency for Western Pennsylvania and Eastern Ohio to sell certain patented articles manufactured by the Brush Electric Company. The Brush Company, he says, has neglected to protect its patents, and they have been infringed upon. The McKeesport Light Company has been purchasing and using double carbon arc lamps manufactured by others than the Brush Company, and they are, he says, an infringement on the patented article he alone has the right to sell in that part of the State. He therefore wants them restrained from using the lamps and that they account to him for those they have bought and used.

On the 15th ult., at Seattle, Wash., a suit for foreclosure was begun in the U. S. Circuit Court against the Ranier Power and Electric Railway Company by the Union Trust Company of New York. The deed to the trust company includes all the property, franchises, etc., and was given in order that the trust company would guarantee the payment of 500 bonds of the denomination of $1,000 each, issued by the railway company. The bonds were made payable October 1, 1911, and were to bear interest at 6 per cent., which was to be turned over to the bondholders through a New York office every six months. The trust company alleges that the street railroad company has defaulted in the payment of interest, but, being in the hands of a receiver, the property cannot be taken possession of without consent of the court.

ATLANTA CONVENTION.

Thirteenth Annual Meeting of the American Street Railway Association.

The Thirteenth Annual Meeting of the American Street Railway Association will be held in Atlanta, Ga., October 17, 18 and 19.

Special committees will report on the following subjects: "A Standard Form for Street Railway Accounts;" "Can the T Rail be Satisfactorily Used in Paved Streets?" "City and Suburban Electric Railways;" "Mail, Express and Freight Service on Street Railway Cars;" "Standards for Electric Street Railways;" "Street Car Wheels and Axles;" "The Best Method of Treating Accidents and Complaints;" "The T Rail Construction of the Terre Haute Street Railway Company," and "Transfers and Commutation." Special Papers will be read on the following subjects: "A Practical System of Long Distance Electric Railway Work;" "Brake Shoes;" and "Destructive Arcing of 500 Volt Fuses."

The large Exposition Building where the sessions will be held is specially adapted to the display of apparatus, and it is believed this meeting will be one of the most successful in the history of the Association.

Eastern delegates and exhibits will leave New York, on a special train over the Norfolk and Western route, at 3 P. M. on Monday, the 15th, arriving in Atlanta the next afternoon. It is intended by the railway company to make elaborate preparation for the comfort and pleasure of the excursionists, and it will pay intending visitors who can reach this city easily to make arrangements to join the Norfolk and Western special at the beginning of the journey.

Out of town friends who desire accommodation reserved on this train should communicate at once with Mr. L. J. Ellis, 317 Broadway, who will have personal supervision of the train.

New York Electrical Society.

Addresses are desired of the following members of the New York Electrical Society, who will oblige by sending their present address forthwith to the Secretary, 534 Temple Court, New York City:

M. W. Grovesteen,
J. D. Bishop,
C. A. G. Groenbeck,
C. G. Curtis,
Albert C. Barrett,
W. L. Tamblyn,
C. H. Wright,
A. G. Holcombe,
W. S. Dix,
R. A. Mitchell,
A. B. Bennett,
W. H. Ripley,
M. B. Meddler,
Alex. MacKinnon,
Herman Wetzler,
A. S. Miskin,
S. V. Hoffman,
James Callopy,
D. H. Washburn,
James Stewart,
C. D. U. Hobbie,
T A. Sherman,
C. C. Sibley,
E. S. Reid,
J. McMahon,
Charles Herman,
J. A. Cabot,'
Thomas Bennett,
E. C. Bischoff,
J. T. Palmer,
E. C. Miller,
J. H. Longstreet,
C. P. Gott,
Francis E. Donohue,
W. Schwein,
H. T. Salmons,
W. B. Heron.

The members of the Society are informed that the photograph, taken by flashlight, of the visitors at the Wild West Show, is now ready, and can be had on application to the photographer, Stacy, 450 Fifth avenue, Brooklyn; price 50 cents.

What the Trolley Has Done at Niagara.

The eighth annual report of the Commissioners of Queen Victoria Park, Niagara Falls, for the year 1893, has just been issued in pamphlet form. It shows that during the year 65,921 carriages entered the park. The number of people entering the park in carriages, on the electric railway and on foot was 543,924. In 1892 the total number of visitors was 233,495 and the electric railway is given credit for the great increase. For the seven months that the road was operated in 1893 it carried over 400,000 people. It is also stated that the traffic in carriages was not diminished, but on the other hand increased, notwithstanding the big business done by the electric road.

A Co-operative Telephone Plan.

Mr. Edward F. Griffin, of Lockport, N. Y., is organizing a new local company, to be called the Lockport Mutual Telephone Company, with the object of putting in a Harrison Telephone Exchange. The plan is to secure as many of the business men as possible as subscribers to the stock of the company, which has been placed at $50 per share. Fifteen per cent. of this amount will be payable on demand and the balance will be payable in 15 per cent. instalments every four months.

The Council have turned down the local Bell Company on the ground of excessive charges, and the Harrison Company is very likely to win.

The Phœnix Carbon Manufacturing Company.

The plant of the Fidelity Carbon Company at St. Louis was dismantled some time ago by its owners, the National Carbon Company of Cleveland.

Mr. S. G. Booker, who was the general manager of the Fidelity Company, thereupon organized the Phœnix Carbon Manufacturing Company and secured the buildings occupied by the former company. The Phœnix Company has a paid-up capital of $100,000, and its prospects for business success are excellent.

Col. Booker is one of the most popular men in the trade, has an extensive acquaintance, and will no doubt make the Phœnix Carbon Manufacturing Company an important factor in the carbon business.

L'Eclairage Electrique, a new weekly journal, directed by M. P. H. Ledeboer, has made its appearance in Paris. It is a continuation, under another name, of *La Lumière Electrique* which lately suspended.

COMMUNICATION.

Heinrici's Electric Fountain Is Not New.

Editor of ELECTRICITY.

DEAR SIR: In your issue of the 26th, under the heading of "An Electric Fountain," you say the idea is something of a novelty. Allow me respectfully to state that in the year 1882 I assisted the late Anthony Reckenyann to make an electric fountain to operate in the drawing-room of the residence of Sir Daniel Cooper, Devere Gardens, Kensington, England. The fountain was made in every particular as you state, less the battery, which was a secondary battery made by the Electric Power Storage Company, Millwall, England. By the above you will see Louis Heinrici's novelty is twelve years behind Anthony Reckenyann's. Yours truly,

STORAGE.

Front Royal, Va., Sept. 27, 1894.

A Telegraph Historical Society.

Preliminary steps have been taken for the organization of a telegraph historical society, the purpose of which will be the collecting, preservation and publishing from time to time of historical information relating to the establishment and development of the telegraph in North America. A large number of the representative telegraph men throughout the country will unite in the undertaking. The gentlemen who began the movement are Mr. James B. Yeakle, general manager American District Telegraph Company, and Mr. George H. Maynard, of Washington, D. C. Other gentlemen interested in the movement are Thomas D. Lockwood, American Bell Telephone Company, Boston; Charles A. Tinker, Western Union Telegraph, New York City; J. H. Emerick, Postal Telegraph, N. Y. City; Charles Selden, Baltimore and Ohio Telegraph, Baltimore; L. C. Weir, Adams Express Company, Cincinnati; Wm. Kline, Lake Shore Railroad, Toledo; A. H. Bliss, No. 2 Sherman street, Chicago; C. W. Hammond, Missouri Pacific Railway, St. Louis; W. C. Walsrum, Roanoke, Va.; B. F. Dillon, Jacksonville, Fla.; James Doyle, the *American*, Baltimore.

Personal.

Mr. C. C. Miller, of the Ft. Wayne Electric Corporation, was in the city last week.

Mr. Chas. D. Shain is improving rapidly from the injury to his leg received several weeks ago, and expects to be as well as ever in another month.

Mr. W. J. Morrison, of Syracuse, was in New York several days last week on business for his company.

Mr. George J. Jackson, of the Norwich Insulated Wire Company, was in Boston last week, looking after some large contracts.

Mr. H. K. Gilman, of Chicago, expects to take a European trip, leaving New York in October.

Mr. James I. Ayer has returned to New York, having been on a Western trip for some time.

Mr. James Godfrey, of the New York Insulated Wire Company, who has been living at Yonkers for some time, has taken up his residence in this city.

Mr. S. A. Douglass, who has been spending a few weeks in Paris, returned to New York on Saturday last.

Col. Bryant, of the Washington Bell Telephone Company, was in New York on Saturday.

Mr. W. S. Norman, general manager of the Washington Water Power Company of Spokane Falls, will be in the city all of this week. He is largely interested in the electric light and railway companies of Spokane Falls.

The Route to Atlanta.

The following announcement is made by the Norfolk and Western Railway, the only line which will run a special train from New York to Atlanta for the benefit of Convention delegates and their friends:

The Royal Blue Line and Shenandoah Valley route will run a special train to the Atlanta Convention of the American Street Railway Association, leaving New York October 15, 1894, at 3 P. M., and reaching Atlanta at 6 P. M. the next day.

This train will carry the representative men in the Street Railway and Supply business. Among those who have already declared their intention of going on this special train are the following named gentlemen:

Benj. Norton, Pres't Atlantic Ave. Railroad Company.
Jas. H. McGraw, *Street Railway Journal*.
E. Peckham, Peckham Motor Truck and Wheel Company.
Henry C. Payne, Pres't American Street Ry. Association.
P. C. Ackerman, American Electric Company.
E. Martin, Vice-Pres't Hamilton Street Railway Company.
C. O. Baker, Jr., Complete Electric Construction Company.
Wm. J. Richardson, Sec'y American Street Ry. Association.
E. J. Wessels, Gennet Air-Brake Company.
Geo. F. Porter, Sec'y National Electric Light Association.
J. B. Griffith, Manager Hamilton Street Ry. Company.
W. J. Clark, General Electric Company.
T. E. Crossman, Asst. to Sec'y American Street Ry. Ass'n.
Wm. W. Cole, Sup't West Side Rd. Company, Elmira, N. Y.
H. C. Evans, The Johnson Company.
Lewis J. Perine, Jr., Pres't Trenton Passenger Ry.
James Godfrey, New York Insulated Wire Company.
John A. Seeley, Complete Electric Construction Company, New York.
B. E. Greene, New York.
George J. Jackson, Norwich Insulated Wire Company, New York.
R. B. Corey Electric Construction and Supply Company, New York.
J. H. Woodward, Benedict & Burnham Manufacturing Company; and a number of others.

A special car will be reserved for gentlemen accompanied by ladies.

As the time is fast approaching when final arrangements should be made by those going to Atlanta, we should be glad to have your order to reserve accommodations for your party on this train.

The railroad fare will be the usual for such occasions, namely, one and one-third fare for the round trip on the certificate plan, one going and one-third of regular rate returning.

The sleeping car fare will be the regular fare in each direction, or $6.00 a berth New York to Atlanta; $5.50, Philadelphia to Atlanta; $4.50 Baltimore to Atlanta; $4.00 Washington to Atlanta; and double these figures for sections. Remittance for the going trip from New York, including sleeping car accommodations, one berth and meals, is $34.00; from Philadelphia, $31.00; from Baltimore, $26.20; from Washington, $24.50.

If you are going, I will be pleased to receive your check for sleeping car accommodations at as early a date as suits your pleasure; or, if you prefer, you can remit the entire amount for the going trip. This may simplify matters for you, and should you find later that you cannot go as expected the money will be refunded on due notice to me. Yours truly,

L. J. ELLIS,
Eastern Passenger Agent.

General News.

What is Going on in the Electrical World.

Brooklyn, N. Y.—The trustees have decided to do away with the oil lamps on the Bridge cars and substitute electric lights.

Sault Ste. Marie, Mich.—The city waterworks will be operated by electricity instead of steam as soon as the change can be made.

Norwalk, Ohio.—An electric line is to be built between Norwalk and Monroeville this fall. Every foot of the right of way has been obtained.

St. Louis.—The Citizens' Railway Company intends to employ electricity as a motive power on its entire line, abandoning the cable system.

Minneapolis, Minn.—The Minneapolis General Electric Company intend erecting a new power station in this city at an estimated expenditure of $200,000.

Webb City, Mo.—The Southwest Missouri Electric Railway Company's line is to be extended from this city to Carthage, making its total length twenty-two miles.

Seattle, Wash.—The city engineer is preparing an estimate of the cost of putting in an electric lighting plant in connection with the waterworks system.

Battle Creek, Mich.—The city council has granted a charter for an electric street railway to the same corporation that is operating the Kalamazoo line. Work will be started at once.

Hamilton, N. Y.—At a special election held here on the 25th ult., 155 votes were polled in favor of having electric lights; against, 1. Whether he was a dealer in tallow or kerosene is not stated.

Palatka, Fla.—The Palatka Electric Light Company has been granted a ten years franchise to operate a system of electric lights in the streets of this city, provided the plant is in operation by January 1.

Scranton, Pa.—The West Side Electric Light Company has absorbed the Kingston Electric Light Company and will henceforth supply the borough, and probably all the West Side, with electric illumination.

Helena, Mont.—The Helena, Hot Springs and Smelter Railway Company and the Union Electric Railway Company have been consolidated under an arrangement satisfactory to the Minneapolis Trust Company.

Junction City, Kan.—E. E. Godlove has been granted a franchise for an electric railway between this place and Fort Riley. He is said to have succeeded in getting St. Louis capitalists to take hold of the project.

Reedsburg, Wis.—A Duluth party has been awarded the contract for putting in the waterworks system here, and the National Electric Light Company of Eau Claire will be given the contract for putting in the electric light plant.

Pottsville, Pa.—The differences between the Schuylkill Electric Railway Company and the Schuylkill Title and Trust Company have been settled, and the railway company is now amply able to carry through all its proposed extensions.

Salina, Kan.—L. M. Erb, of Leavenworth, submitted a proposition to the Commercial Club to put in an electric car line here. The proposition was accepted; work is to commence within thirty days and the line is to be completed in four months.

Lambertville, Pa.—Edward R. Solliday, receiver of the Lambertville Electric Light and Power Company, has sold the plant to D. Stuart Robinson, of Philadelphia, for the sum of $10,050 clear of incumbrances. The plant cost $33,500 to build.

Milwaukee, Wis.—City Engineer Benzenteng has been requested by the special committee on electric lighting of the common council to prepare figures showing the approximate cost to the city of a new system for the lighting of the streets by electricity.

Martin's Ferry, O.—The electric light plant will be rebuilt, the town having voted for a new plant to replace that which was burned. The matter has been in litigation for months, during which time the streets have been neglected. The new plant will be rebuilt as soon as possible.

Quebec, Can.—The Montmorency Electric Power Company has made a contract with the Stanley Electric Manufacturing Company, of Pittsfield, Mass., for a plant which will cost altogether considerably over $60,000, including three machines of over 2,000 horse-power.

Spokane, Wash.—Municipal lighting is growing in favor here, and a scheme proposed is to cut out one of the four pumps at the new water station and use the power derived from this source to generate electricity for lighting the streets and public buildings.

East St. Louis.—A stock company is to be organized here to run an electric car line over the Venice and Carondelet belt from the Merchants' Bridge to St. Louis. Dwight Tredway, of St. Louis, was chairman of the meeting called for the purpose of forming the company.

Syracuse, N. Y.—Steps are being taken to organize a street railway company to construct and operate a line extending from the center to the northeastern limits of the city. Among those interested in the project are Frank M. Bonta, Dr. D. H. Murray, Nathan F. Graves and Lyman Stevens.

Baltimore, Md.—A dispatch to the *Sun* from Hyattsville, on the 23d ult., says: "There is no longer any doubt about the construction of the electric railway between Washington and Baltimore. Work will be commenced on the road within the next fifteen days. The contract will be let for the entire route within the next week."

Oswego, N. Y.—Sealed proposals will be received by the Board of Public Works until October 25 for supplying electric light to the streets and municipal buildings of this city for a term of five years from February 20, 1895; 190 arc lights and 230 incandescent lights are required. Inquiries should be addressed to the Board of Public Works, Oswego.

Bennington, Vt.—The State Legislature when it meets this month will probably be asked to grant a special charter for an electric railway from Bennington to the New York State line, connecting with the Hoosick Railway. A committee composed of Major A. B. Valentine, A. P. Childs, E. L. Sibley, N. M. Puffer and E. E. Larrabee has charge of the matter.

West Hoboken, N. J.—The contract for furnishing an electric fire alarm system, with fifteen signal boxes, three public alarms and indicators in the chief's residence and engine houses, the same to be completed within two months, and kept in repair for one year, was awarded to the Gamewell Fire Alarm and Telegraph Company, whose bid was $4,000.

Reading, Pa.—The Reading Railroad Company has just put into operation a new and complete system of electric automatic block signaling, extending over the line of the Reading Terminal to and including Jenkintown. The signals are operated entirely automatically, the passage of each train along the rails actuating the signals in the rear by means of electric currents.

Salt Lake City, Utah.—The great water power reservoir in Big Cottonwood cañon is nearing completion very rapidly. Unless unforeseen accidents interfere, the entire work will be finished by the 15th of November, and the company which is engineering the undertaking will be ready to make good their offer of electric power and lights to the city and to the street car lines at greatly reduced rates.

Wilkesbarre, Pa.—Articles of association have been filed in the Recorder's office here by the Nanticoke and Newport Railway Company, who are to build an electric railway ten miles long to connect Nanticoke, Glen Lyon and Wanamie. The capital stock is $60,000. K. M. Smith, of Newport, is president; the directors are George T. Morgan, Wm. Fairchild, Henry Schappert, B. A. Bache, T. D. Garman and B. Jackson, all of Nanticoke.

Avon, N. Y.—Messrs. C. J. Bastendorf and A. E. Young have organized the Avon Electric Light Company and are putting in a plant to light the village. A handsome building of stone is being constructed for the station. Mr. W. J. Morrison, Syracuse, N. Y., has closed a contract for the apparatus. There will be a 1,000 light Ft. Wayne alternator to start with. The boilers will be furnished by the Stearns Manufacturing Company of Erie.

New York.—The electric organ in St. Bartholomew's Church, Madison avenue and Forty-fourth street, one of the largest organs in the country, is now finished. Although there are electric organs in several churches in the city, St. Bartholomew's is peculiar in that the tubular pneumatic and electric action are combined, so that three volts are enough to operate the instrument, and the expense of an electrician in constant attendance is not necessary.

Montreal, Can.—At the recent meeting of the Canadian Electrical Association, Carl Breipthaupt read a paper in which he argued strongly against municipal ownership of lighting plants. M. J. Francisco, of Rutland, Vt., president of the N. E. L. Association, said he had travelled 7,000 miles looking into the question of municipal ownership and not once was it shown that a municipality can furnish light more cheaply than a private company under similar conditions of lighting and bookkeeping.

Lancaster, Pa.—A deal has just been completed between the Pennsylvania Traction Company and the New Holland Turnpike Company by which the former leases the latter's turnpike between Lancaster and New Holland for 999 years. The Traction Company will build within 90 days a line of electric railway along the turnpike, paying a percentage of the receipts as rental for the turnpike, and as soon as the line is in successful operation it will be extended to Terre Hill, a large cigar manufacturing centre.

Berlin, Wis.—A company known as the Waushara Telephone Company has been organized here to construct, maintain and operate a line from Berlin to Wautoma via Auroraville, Poy Sippi, Pine River, Mt. Morris and Silvercryst, with a capital stock of $4,000. The officers are as follows: John Moffott, of Poy Sippi, president; D. J. Jenu, of Auroraville, vice-president; J. E. Whitney, of Silvercryst, secretary, and L. E. Davis, of Berlin, treasurer. It is expected to construct a line directly and have it in operation this fall.

Washington, D. C.—President Phillips and Chief Engineer Connett of the Metropolitan Railroad Company are on a tour of investigation relative to the workings of the various underground electric systems in cities where such are in operation. Mr. Phillips said upon assuming the presidency that he was not wedded to any particular sort of underground electric system, but that he proposed that the Metropolitan should have the best and most practicable, regardless of expense. The road is three and one-half miles long, and it will cost somewhere in the neighborhood of $300,000 to equip it with a completed system, including cars and power houses, such as is intended to be put in.

Rochester, N. Y.—The *Post-Express*, referring to the Albion Electric Light Company, speaks in flattering terms of the management of its plant, which is under the superintendence of J. H. Rollins. "There are in operation," says the *Express*, "2,450 incandescent lights, 16 candle power each, and 50 arc lights. Over one-half the lights are in private residences throughout the village. Steam is furnished by a 200 horse power boiler and the dynamos, three in number, are propelled by a 192 horse power engine. It is the Westinghouse system, and this much can be said, since the plant has furnished light for our streets, residences, stores and public buildings, that during its existence the incandescent lights have only been out four hours, and the cause was an accident. The company also lights the churches and furnishes 518 lamps for the Women's Refuge Building."

Philadelphia.—The change of the horse-car line on Girard avenue to the trolley system, new cars being put on, was made in one hour on the evening of the 26th ult. So perfect were the arrangements of General Manager McIntyre that the change was made without a hitch.—The annual meeting of the Penn Electric Light Company, of this city, which should have been held June 27 but was postponed by order of the Court of Chancery, was held in Camden, N. J., on the 26th ult. (the company was chartered under the laws of the State of New Jersey). A. J. De Camp presided. Of the 800,000 shares of stock into which the company's stock is divided 435,555 were voted and resulted in the election of this board of directors: Henry Clay, David H. Lane, W. D. Marks, C. W. Taylor, James McManes, A. R. Little, A. J. De Camp, Thomas Bush, Walter F. Smith, Joseph I. Patton and F. A. Crowell. A. J. De Camp was chosen president, Joseph I. Patton secretary, and F. A. Crowell treasurer.—The *Herald* says: "No person familiar with the city of Philadelphia who possesses ordinary power of observation can fail to note the fact that the city is going through a transition state, that it is being rapidly revolutionized, and that the term 'center of Philadelphia' is becoming more and more possessed of uncertain meaning. The trolley lines are changing the character of Philadelphia as it has never been changed before. There is no city in the United States that covers such a large area of ground as Philadelphia, and there is no city possessed of such facilities for quickly reaching every section, near or remote, as Philadelphia has."

The Book of the Fair.

Parts 12 and 13 of the "Book of the Fair" have reached us from the publishers, the Bancroft Company, Chicago.

The high standard of the work is maintained, and it easily takes the lead among all the works purporting to present a review of everything connected with the great Fair.

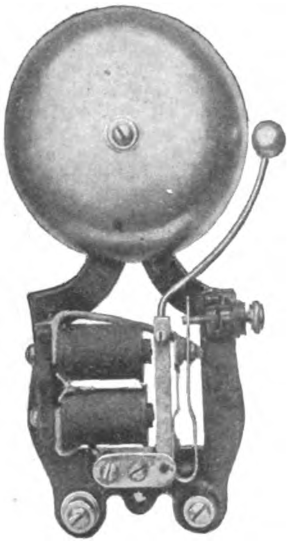
Part 12 concludes the description of the horticultural and forestry displays, and begins the account of what was shown in the Mining Building.

Part 13 begins the story of the Fisheries exhibit, which was really one of the most interesting of the entire show.

The office of the publishers is in the Auditorium Building, Chicago.

The Varley Bug-proof Bell.

The race of bugs which, according to nursery rhymes, was supposed to be happily domiciled in some convenient rug, or rugs, has apparently died out or else unanimously cancelled their lease on rug properties and moved to mansions higher up—on the wall. Any bell-hanger who has gingerly jabbed bugs out of a bell and chased them out of annunciator cases will readily concur in the supposed exodus. Of late years it has been the constant effort with manufacturers to construct a style of bells that would effectually bar these unwelcome tenants. But the bugs have always roosted around the cheerful blaze of the contact points just the same. In the Varley bell, which we illustrate, this single vulnerable point has been ingeniously protected by a small elastic covering that completely encloses the solid platinum contacts, but does not in the least restrict the free vibration of the clapper. The bell being otherwise of the open frame construction, there are no inviting nooks where bugs will gather. The magnets are duplex wound and so arranged that the armature gets the full benefit of the "pull" and can be operated with much less battery than is needed with an ordinary bell. All adjustment screws have lock-nuts so that they cannot work loose. It seems an admirably constructed bell in every way. The Central Electric Company, 173-175 Adams street, Chicago, are making it one of their specialties and report a very satisfactory demand from dealers who buy the better grades of electrical merchandise.



THE VARLEY BUG-PROOF BELL.

The Siemens & Halske Company's Catalogues.

We have received the September catalogues of the Siemens & Halske Electric Company of America, containing descriptions of their Type I Generators and Motors (internal pole machines), and their Bi-polar Generators and Motors, Type L H, with photo-engravings of the machines, showing their appearance when in place, their peculiarities of construction and their manner of operation, also views of their Generators as installed in the stations of the Cincinnati Street Railway Company (750 H. P. Railway Generator direct-connected to Buckeye Tandem Compound Engine); John B. Stetson, Philadelphia (two 82 K. W. 120 volt Generators direct-connected to New York Safety Engine); Temple College, Philadelphia (35 K. W. Generator direct-connected to Ames Engine); Union Trust Building, St. Louis (40 K. W. Generator direct-connected to Russell Engine); and St. Louis Terminal Railway Association (one 140 K.W. Generator and two 66 K.W. Generators direct-coupled to Buckeye Engines, operating 4,000 incandescent and 250 arc lamps).

The catalogues may be obtained by applying at any of the branch offices of the company.

"Advertising for Profit"

Is the title of a neat little handbook, just issued, in which the purposes and methods of the Manufacturers' Advertising Bureau and Press Agency are set forth clearly and concisely. This Agency was established in 1879 and claims to be the largest user in the world of advertising space in the trade journals. Mr. Benj. R. Western, its proprietor, was a practical journalist and connected with some influential periodicals before entering the advertising field. The large clientage he has gained in this exacting business is convincing proof of his tact, judgment and reliability in dealing with advertisers and publishers. The handbook referred to gives a long list of his patrons and many favorable testimonials from individuals and firms whom he has served; it can be obtained on application to the Manufacturers' Advertising Bureau and Press Agency, 111 Liberty street, New York.

The Consolidated Car-Heating Company.

In order to meet the demand for the Pope light, which is interchangeable with the "Pintsch," now in wide use, the Consolidated Car-Heating Company, of Albany, N. Y., has added considerably to its plant, and is about to manufacture lamps for compressed oil, gas and fittings on a large scale. The Consolidated Company is preparing to notify railway men from all over the country to witness an exhibit of Pope lighting apparatus at Albany, carrying out a similar plan to that established in 1892, when many prominent railway officials from all parts of the country and Canada were present to observe the operation of the Sewall coupler and commingler storage systems.

COMMERCIAL PARAGRAPHS.

The Metropolitan Electric Company have taken the agency for the Commercial Electric Company's Dynamos and Motors, and carry a large stock from which to fill orders promptly. One of the important agencies that the Metropolitan Electric Company list is the Royal Transformer. These transformers are being made especially for the Metropolitan Electric Company. As soon as possible, they will carry a full stock. They are booking orders and have found a ready demand for a good transformer in all sections of the country.

The Okonite Company, Limited, New York, now have a branch at Pittsburg. This will prove a convenience to many users of Okonite specialties and should largely increase the business of the company in that territory.

The Mather Electric Company of Manchester, Conn., report on hand a large number of contracts for their new Multipolar Railway Generators for railway work. They have this week closed the following contracts: The Danbury and Bethel Horse Railway Company of Danbury, Conn., for two 100 K. W. multipolar railway generators, with very elaborate and complete switchboard, which will be fitted entirely with new Mather station instruments; the Chicago City Railway Company, Chicago, Ill., one 125 H. P. direct-connected generator.

INCORPORATIONS.

The New Castle, Minersville and Tremont Street Railway Company, Carlisle, Pa.—to construct, maintain and operate an electric railway. Capital stock, $100,000. Promoters: Elias Davis, Broad Mountain, Pa., Lewis S. Sadler, W. F. Sadler, Jr., of Carlisle, Pa.

The Long Island Co-operative Telephone Company—to extend facilities for communication by telephone throughout Long Island, N. Y., by constructing lines and operating them in connection with other companies. Capital stock, $20,000. Directors: S. J. Seaman and S. B. Bowne, Glen Cove; Wilbur F. Johnson, East Norwich; Dr. George W. Fuller and William L. Swan, Oyster Bay; Joseph Steinert and J. H. Hahn, Hicksville; Dr. John Mann, Jericho; John Devine, Syosset.

The Wadsworth General Electric Company, Wadsworth, Ohio—to build and operate electric railways, electric light, electric telephones and telegraph, furnishing electric power, etc. Capital stock, $10,000. Promoters: W. R. Hunsberger, Eli Overholt, John A. Clark, A. M. Reck, E. G. McCauley, O. V. Dibble, J. P. Baldwin, I. G. Grismer.

The N. W. Turner Company, Boston, Mass.—to purchase and sell merchandise, gas and electric fixtures and lamp goods at wholesale and retail. Capital stock, $10,000. Promoters: Clarence B. Knott, Nathaniel W. T. Knott, Wm. F. Schallenbach, all of Boston.

The Philadelphia, Bala and Narberth Railway Company, Philadelphia, Pa.—to construct, maintain and operate an electric railway. Capital stock, $24,000. Promoters: A. L. Fretz, Cynwyd, Pa.; G. Morris Dorrance, Bristol, Pa.; J. L. Stadelman, Bala, Pa.

The Texas Pacific Mercantile and Manufacturing Company, Ft. Worth, Texas—to construct telegraph and telephone lines, maintain stage line and hotel, supply light, heat, etc. Capital stock, $20,000. Promoters: R. D. Hunter, H. C. Edrington, H. K. Thurber, S. Mims, W. C. Newby, Ft. Worth, Texas; C. V. Siddell, New York City.

Electric Railway and Park Company, Clinton, Iowa—to construct and operate street railways, own and operate a pleasure park. Capital stock, $50,000. Promoters: A. L. Schuyler, C. Coan, E. C. Walsh, A. L. Stone, M. A. Walsh, J. W. Walsh, Clinton.

The Garven Electrical Manufacturing Company, Portland, Ore.—to manufacture, purchase and lease telephones, phonographs and all other classes and kinds of electrical inventions. Capital stock, $5,000. Promoters: Wm. H. Garven, Thos. B. Howes, S. I. Barber, Portland.

Articles of incorporation have been filed with the County Clerk at Los Angeles, Cal., by the Electric Power Company, formed for the purpose of acquiring and dealing in water rights and water, furnishing, selling or leasing power, heat and light created by the use of electrical apparatus, etc. Capital stock, $1,000,000, of which $500,000 has been actually subscribed. Directors: E. C. Seymour, P. Kehl and W. E. Van Slyke, all of San Bernardino, and M. L. Graff and H. W. Latham, of Los Angeles.

The Signal and Control Company (incorporated in W. Va.), New York, N. Y.—to purchase, manufacture and sell mechanical, electrical and other apparatus, etc. Capital stock, $1,000,000. Promoters: Norman Seymour, New York City; Harvey B. Seymour, Flatbush, N.Y.; J. H. DeBevisse, Brooklyn, N. Y.

The Hillsboro Light and Fuel Company, Hillsboro, Ohio—to manufacture and furnish gas, supply electricity for light and power, etc. Capital stock, $20,000. Promoters: J. R. Cook, E. W. Bixby, H. H. Campbell, Chas. Horn, G.H. Moore.

The Co-operative Construction and Supply Company, Norwalk, Ohio—to engage in making and selling steam power and electrical current, electrical and hydraulic engineering aad fitting, etc. Capital stock, $20,000. Promoters: D. B. Kuhn, Wm. S. Bayley, Wm. J. Bowen, John Comesky, Michael Muller.

The Cumberland Light, Heat and Power Company, Mechanicsburg, Pa.—to supply light, heat and power by means of electricity to the public in the borough of Mechanicsburg, Pa. Capital stock, $50,000. Promoters: Geo. W. Cumbler, Fred'k H. Alleman, Jacob D. Landes, Steelton, Pa.

The Nexophone Company, Chicago, Ill.—to make, sell and lease nexophones and other electrical appliances. Capital stock, $200,000. Promoters: Frank W. Campbell, Freeman Campbell, Chas. F. Congleton.

The Citizens' Electric Company, Springfield, Ill.—to produce and furnish electricity for light, heat and power, and to use and furnish electrical applications. Capital stock, $60,000. Promoters: Jno. McCreery, Fred. D. Buck, T. H. Coleman, P. N. Harts, Edwin A. Wilson.

The Electric Switch and Trolley Company, Newark, N.J.—the acquirement of patents for electric switches, electric motors, etc., and the manufacture and sale of electric switches, motors, etc. Capital stock, $5,000,000. Incorporators: Emile Reiser and Joseph Campbell, New York City; Geo. W. Littell, Cranford, N. J.

The Bay State Subway Conduit Company, Portland, Me.—to construct, buy, sell, lease and operate subway conduits under sidewalks, across or through streets, for the purpose of conducting electric telephones or other wires or cables, pneumatic or speaking tubes, for commercial intercourse, and to hold real and personal estate to the value of $500,000. Capital stock, $500,000, of which $250 is paid in. Halsey J. Boardman, of Boston, Mass., is president of the company, and E. Dudley Freeman, of Yarmouth, Me., is treasurer.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED SEPTEMBER 25, 1894.

ELECTRIC RAILROADS AND APPLIANCES.

526,392. Conduit for Electric Railways. David F. Graham, Springfield, Ohio, and William P. Allen, Chicago, Ill., assignors of one-third to Oliver S. Kelly, Springfield, Ohio. Filed Oct. 25, 1893.

526,408. Bracket for Trolley Wires. Leroy S. Pfouts, Canton, Ohio. Filed Dec. 30, 1893.

526,409. Trolley and Feed Wire Bracket. Leroy S. Pfouts, Canton, Ohio. Filed Jan. 11, 1894.

526,422. Trolley-Wire Hanger. Irvin B. Walker, Sioux City, Iowa. Filed Feb. 26, 1894.

526,468. Closed Conduit for Electric Railways. Charles D. Tisdale, Boston, Mass., assignor to himself and John D. Gould, New York, N. Y. Filed Sept. 4, 1893.

526,644. Testing-Indicator for Electric Railway Cars. Theodore Stebbins, Boston, Mass. Filed Aug. 21, 1890.

ELECTRIC LIGHTS AND APPLIANCES.

526,579. Registering Mechanism for Electric Light Circuits. William McNeill, Chicago, Ill., and James H. Tinder, Winchester, Ky., assignors to the McNeill-Tinder Electric Company, Winchester, Ky. Filed July 26, 1893.

MOTORS, DYNAMOS, ETC.

526,432. Means for Driving Dynamos from Car-Axles. William Biddle, Brooklyn, assignor to the American Railway Electric Light Company, New York. Filed Oct. 20, 1893.

526,583. Voltage Regulator for Dynamos. Malcolm P. Ryder, New York, N. Y. Filed May 12, 1894.

TELEPHONE AND TELEGRAPH APPARATUS.

526,608. Coin-Controlled Telephone Apparatus. Charles C. Blake, Boston, Mass., assignor to the American Bell Telephone Company, of Massachusetts. Filed Feb. 6, 1894.

SIGNALS AND SIGNALING APPARATUS.

526,414. Electric Signal Apparatus. Wilmer W. Salmon, Chicago, Ill., assignor to the Hall Signal Company of Maine. Filed Feb. 1, 1894.

526,415. Electric Signal Apparatus. Wilmer W. Salmon, Chicago, Ill., assignor to the Hall Signal Company of Maine. Filed Feb. 1, 1894.

526,598. Electric Cab-Signal for Railways. Edgar C. Wiley, Bristol, Tenn. Filed Jan. 31, 1894.

526,609. Submarine Signaling. Lucien I. Blake, Lawrence, Kan. Filed July 6, 1894.

MISCELLANEOUS.

526,388. Coin-Controlled Electrical Apparatus. Henry F. Galligan, Lebanon, Mo. Filed April 16, 1894.

526,472. Insulator for Electric Conductors. George Webster, Philadelphia, Pa., assignor of one-half to Arthur J. Ingraham, same place, and Samuel H. Brown, Bala, Pa. Filed July 26, 1894.

526,482. Apparatus for Electrodepositing. Henry L. Bridgman, Blue Island, Ill. Filed Oct. 3, 1893.

526,487 Electrical Measuring-Instrument. Hermann Herberts, Schenectady, N. Y. Filed March 5, 1894.

526,498. Conductor Support and Insulator. David N. Osyor, Columbus, Ohio, assignor to Joseph A. Jeffrey, same place. Filed Nov. 29, 1893.

526,605. Rheostat. Burton E. Baker, New Britain, Conn. Filed June 4, 1894.

ELECTRICITY.

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EDITORIAL NOTES.

Galvanizing the Corpse. Mr. Coffin is as busy as ever supplying information as to the condition of his company. A sample of the latest is as follows:

The General Electric Company continues to increase the size of its cash balance, which now amounts to $650,000 besides the $650,000 invested from its treasury in the purchase of its own bonds, and is in a quandary how to use its surplus capital.

Business is steadily improving, orders for the last week being most satisfactory. It is now believed that the gross business of the company will foot up $15,000,000 this fiscal year. At present it is almost double what it was during the panic.

During the panic the business of this company was about $300,000 a month. It is now at the rate of less than $750,000 per month, or $9,000,000 for the year. The actual business for the year will be, unless some miracle happens in the next four months, less than $8,000,000. As for finding a place to use their surplus capital we do not wonder that they are in a quandary, though not for the reasons implied in the above, which is a specimen of the "news" officially given out to such subsidized financial writers as are willing to print anything for a consideration. There are dozens of places to put any "surplus money" which may be in the treasury. There is, first of all, a deficit of about $20,000,000 to be made good. There are aching voids without number—some debts to pay, some guarantees to make good, some damage claims, amounting to hundreds of thousands, from Edison Licensees; there are worthless securities turned over to the financing companies, and which must be replaced either with good securities or with currency; there are passed dividends on preferred stock, which is a lien on the assets of the company, coming before the bonds in liquidation.

If no other way suggests itself, the company might buy back from the Illuminating Properties some of the securities worth dollar for dollar which were turned over to the latter a year ago, on which an illegitimate profit is being realized of about 300 per cent., the stockholders of the G. E. Company being robbed in that transaction of about $7,000,000.

In a quandary? Of course they are. They have been in a quandary ever since ELECTRICITY told the directors that the company was a flat failure and convinced them of the truth of our charges.

They will continue to be in a quandary until they reorganize the company, get rid of all their nincompoops and featherheads, scale down their capital stock, and take their place with as good grace as possible in the ranks of the other electrical companies, hustling for business on business-like principles, and selling goods on their merits.

There is no quandary whatever among thinking men as to whether they will or will not be compelled to do this. The only thing to guess about is as to how long the present group of incompetents can fool the directors—how long before the reorganization will take place.

Speaking of "surplus capital," the term is a misnomer. There never was an honest surplus in the treasury of this company from the date of its organization to the present time.

* * *

Franklin Institute Awards. The Committee on Science and the Arts of the Franklin Institute have just announced the awards of the John Scott Legacy Premium and Medal to Clement Payen for the invention of the chloride electrical storage battery and to Alexander Jay Wurtz for improvements in lightning arresters, both of which inventions will be remembered from former descriptions in ELECTRICITY.

The report of the sub-committee appointed to investigate the chloride storage battery is printed elsewhere and contains a very flattering endorsement of the qualities which its inventor claims for it. As these examinations and tests of inventions are made by the Institute solely in the interest of science, and without the co operation or even the knowledge of any interested parties, the awards are correspondingly of value as being free from any advertising or other financial considerations.

The investigation of the chloride storage battery has been in progress for several months and during the whole time has been not only a test of this individual cell, but a comparison between it and a number of cells of the same size made by several other manufacturers. Under these conditions the committee has found that the chloride battery contains several features which, in the opinion of the investigators, prove it to be both theoretically and practically a distinct improvement over any of the other forms of cells hitherto invented, and the qualities chiefly constituting its superiority are stated in the report to be greater durability, greater capacity for a given weight, and larger discharges without injury than can be obtained in any other class of cell.

The report on the Wurtz lightning arresters also recognizes these appliances as a decided improvement over former apparatus of this character. In addition to the discovery of non-arcing metals, announced some time ago, Mr. Wurtz's inventions cover a number of lightning arresters based on this discovery which are designed for different kinds of circuits and for both direct and alternating currents. In almost all lightning arresters brought out prior to those devised by him the action has been based upon the knowledge that such discharges tend to ground even through a considerable air gap more readily than they will follow a longer path of much lower resistance. This method of discharging a line, however effective in regard to the lightning, is open to the objection of forming a serious short circuit, especially where grounded circuits are employed, as the lightning in forming an arc across the air gap of an arrester is followed by the dynamo current, thus forming a short circuit which blows the fuses on the main line and cuts off the station current.

It is in this connection—the use of a non-arcing metal, or one which by its inherent properties prevents the continuance of an arc already formed—that the discovery of Mr. Wurtz finds an important application, and the Franklin Institute Committee have found the arresters so designed the most effective in preventing damage without interfering with the operation of the generating plant.

* * *

Popular Electrical Literature. The use of electricity has now become so general for many purposes that scarcely a day passes without some reference to the subject in the news columns of the daily press, and although the time has passed when a description of anything electrical was supposed to border on the miraculous, the subject is still utilized for occasional popular sensations. In probably nine cases out of ten, articles of the class to which we allude contain very questionable information which is much more surprising to an electrician—or would be, if correct—than to the general public.

Two brilliant examples of this style of literature are mentioned in the columns of an English contemporary before us, which are not more remarkable in the extent of their misinformation than many of the same kind that are published daily. One of these scientific (?) items follows:

> "I hear on good authority that those tramcars in American cities worked by electricity will shortly be equipped with telephones for the use of passengers. The message will be carried on the overhead wire that supplies the motive power to the car to the company's headquarters, where it will be switched on to one of the telephone company's exchanges."

This will certainly be news to the patrons of our trolley cars who have not as yet been apprised of this innovation, and if it were not for the fear that some enterprising daily contemporary would credit us with another wonderful invention we would suggest that each trolley car be equipped with a telegraph station which could be operated in the same general manner.

An equally ridiculous account of a dynamo room is also quoted, in which the following occurs:

> "Each machine was propelled by means of a wide leather belt passing through a pulley at the end of the dynamo. The pulley revolved at a very rapid rate—some 600 or 700 revolutions per minute—and the electricity was generated by the pulley causing another wheel in the middle of the machine to revolve among some coils of wire. The electricity was then collected, and taken away at the far end of the machine, away from the pulley that supplied the power from the steam engine."

For a description of the dynamo this account rivals anything we have seen in scientific literature both for simplicity and brevity, and although devoid of any special meaning is not calculated to mislead anyone seriously.

Another intelligent writer in a New York daily, in commenting on an addition to an electrical plant, says that the old plant "requires about $1\frac{3}{4}$ pounds of dry steam for each horse-power delivered from the dynamo," while the new plant "represents one of the highest types of modern electric and steam engineering and requires about 18.19 pounds of dry steam for each horse-power delivered from the dynamo, and is therefore somewhat more economical than the original system!"

It is certainly evident from such illustrations that if the daily newspapers find it necessary to comment on technical matters such articles should either be referred to the technical editor, or, in his absence, be printed in the joke column, in order that the public may appreciate them at their true value.

* * *

We shall begin next week a brief series of articles dealing with the affairs of the Pennsylvania General Electric Company, prepared by a member of our staff, who was recently called upon to investigate this subject for an investor. Incidentally there will be considerable information contained therein for the Edison Licensees. We shall be able to show specific cases where Edison Licensees have been compelled to pay more for their apparatus than their competitors, who should not, if the parent company had lived up to its contracts, have been able to buy any Edison apparatus whatever from the G. E. Company. We will also show, we think, why the Pennsylvania General Electric Company is kept in existence in spite of the fact that its books show a continual loss of from $6,000 to $8,000 a month.

* * *

We learn from newspaper reports that owing to dissatisfaction with the services of his generals, the Emperor of China has appointed a number of committees, who will hereafter conduct the war with Japan. We suppose the Emperor must have got his idea for this plan from the conduct of the G. E. Company. If it works as well in China as it has here the Japanese will be in full possession of Pekin before this paper reaches our readers.

"All Aboard for Schenectady."

(From the Albany Argus.)

Among the new arrivals in the city this winter who will be welcomed by the smart set, and who will doubtless do considerable entertaining, are Mr. and Mrs. Eugene Griffin, of New York, who will reside at 323 State street. Mr. Griffin is vice-president of the General Electric Company. Mr. Henry W. Darling, treasurer of the same company, has leased the handsome Norton residence, No. 300 State street, which last season was the scene of so much delightful entertaining when occupied by Lieut.-Gov. and Mrs. Sheehan.

Marriage of Mr. W. S. Barstow.

Mr. W. S. Barstow, the well-known superintendent of the Brooklyn Edison Company, and Miss Frances W. Du Clos, of Highland Park, N. J., were married on Thursday evening, October 4th, at New Brunswick, by the Rev. E. B. Joyce. The bride is a sister of Mrs. Chas. L. Edgar, of Boston. Among the many presents was a magnificent silver service from the directors of the Brooklyn Company.

Death of W. J. Gordon.

Mr. W. J. Gordon, who had been very ill at his home in New Jersey for several months, died on Monday, October 1. The body was taken to Cincinnati for burial.

Mr. Gordon had formerly been a grain speculator in Chicago, and entered the electrical trade as agent for the Simplex Wire Company. He subsequently went into business for himself under the firm name of W. J. Gordon & Company. The venture was not successful.

He was well known to all members of the old Electric Club, who will remember him as a generous and jovial companion, and will hear of his death with honest sorrow.

Ft. Wayne Corporation News.

Mr. Charles S. Knight, of the Ft. Wayne Electric Corporation, was in town for several days last week. The New York offices of the company have been enlarged. Mr. Stephen A. Douglass, who earned a high reputation as a successful salesman with the Edison General and Brush companies, has taken charge of them, and will have as territory New York State and parts of Connecticut and New Jersey.

Mr. W. J. Morrison, who has been with the Ft. Wayne interests for six years, with offices at Syracuse, has resigned. Mr. Morrison will no doubt still be connected with the trade, in which he has made many friends.

Personal.

Mr. John B. Wallace, of the Wallace Electric Company of Chicago, and Mr. George A. Redman, of Rochester, N. Y., were among our New York visitors this week.

Mr. H. K. Gilman, business manager of the Great Western Manufacturing Company, has been obliged to sever his connection with that concern on account of ill health. Mr. Gilman intends to make a trip abroad for several months, and it is hoped that on his return his health will permit him to resume his former duties.

Underground Work is Booming.

The Norwich Insulated Wire Company, makers of "paper cable," have closed two large railway contracts recently, one with the Yerkes system in Chicago, the other with the West End Company of Boston. The former calls for nearly 40 miles, the latter for 30 miles, 500,000 circ. mils.

This company has booked orders within the past 30 days amounting to over $400,000.

The Chloride Electrical Storage Battery.

Report of the Franklin Institute Committee on Science and the Arts on the Invention of Clement Payen.

The Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts, acting through its Committee on Science and the Arts, investigating the "Chloride Electrical Storage Battery," finds as follows:

The sub-committee appointed to conduct this investigation has had this battery under careful consideration for a number of months, and has investigated the several features which are claimed to give it merit. During the larger portion of the time a number of cells have been in possession of the committee, and have been placed upon a regular working circuit under the control of one of the committee's members, where they have been subjected to exactly the same usage as a number of other storage cells of other makers and of the same size, so that opportunity was thus given to obtain the results of the performance of the chloride storage battery in regular use, which is ultimately the final test by which the utility of all inventions and improvements must be measured.

The results of this examination have led to the opinion that this battery embodies certain features of construction which prove it, both theoretically and as verified by use, to be a distinct improvement over hitherto known forms of storage batteries. In order to fully appreciate these features of improvement it will be necessary to recapitulate, briefly, a few well-known facts regarding storage batteries in general.

In all lead storage batteries one of the objects desired is to obtain a large lead surface for small mass, as the capacity and discharge rates are strictly proportional to the amount of surface involved. This necessary maximum of surface has hitherto been obtained in one of two ways. The earlier way was to slowly eat out the lead plates by electrolysis until they had attained the requisite spongy condition, an affair of some time and expense. The later way—and the one which is generally practised—is to cast a frame of lead, with raised right-angled ribs on each side, thus forming little depressed squares, or to punch a lead plate full of holes, which squares or holes are then filled with a pasty mixture of red oxide of lead in positive plates, and with litharge in negatives.

For several reasons cells made in this way have always given more or less trouble in service. In the first place, after continued use or during heavy discharges, a greater or less amount of mechanical disintegration of the positive plates would often take place, small fragments of lead and lead oxide dropping down between the positives and negatives, short circuiting them and often causing further and more serious break-up, buckling and sulphating. Even when these particles are prevented from falling their mechanical looseness causes poor contact with the supporting lead frame, thus entailing increased internal resistance and heating with diminished output. This disintegration appears to be due largely to the fact that the lead oxide paste placed in the holes is a mechanical rather than a chemical mixture, and hence that in changing from PbO_2 to $PbSO_4$ during the action of the cell, the molecules being only related to one another in a fortuitous manner, are easily broken up and thrust apart in the change of volume attending the chemical action. This, of course, seriously limits the life of a battery and its utility for public service.

In the chloride battery it is claimed, and the committee's investigations go to confirm the correctness of the claim, that the method of construction is such that this disintegration is far less liable to occur. This mode of construction is as follows:

Instead of cementing lead oxide paste into or against a lead framing in order to obtain the necessary active material, the latter is obtained by a strictly chemical process. Lead chloride is taken, mixed with a given proportion of zinc chloride, and this mixture is then fused and cast in small squares in suitable moulds. When thus cast the product is of whitish color and vitreous character, being quite brittle.

For the negative plates, these blocks are about $\frac{3}{4}$ inch square and $\frac{5}{16}$ inch thick, and are cast in groups of four, these groups being united by portions, having, say, $\frac{3}{32}$ to $\frac{1}{8}$ inch thickness. For positives, the fused mass is cast in separate lozenges, each lozenge having a bevelled V-shaped periphery. These cut squares or lozenges are then placed in a suitable mould, and a molten mixture of lead and antimony, in proper proportions, is cast about them under high pressure, thus fixing them securely in a firm lead framing of somewhat more than the usual density. (The feature of casting under pressure is an improvement in manufacture, due to Mr. H. Lloyd, who is connected with the American makers, and the process is protected by patents granted to him). The connecting sheets of the squares making up a group and the V-shaped bevel of the lozenge serve to make their solidity of fixation exceedingly good.

The frameworks containing the chloride castings are then placed in a dilute solution of zinc chloride, together with plates of zinc, the frames and zinc plates being alternated with one another and in metallic contact. This combination is the equivalent of a primary battery "dead short-circuited." The chemical reactions which occur result in the removal of the zinc chloride and the chlorine of the lead, and there remains finally the dense framing containing squares or lozenges of spongy lead, which plates are then "formed" in, practically, the usual manner.

If a section of the spongy lead thus made be examined, it is found that the metal is in a crystalline condition, and that the crystals are all uniformly arranged with their longer axes perpendicular to the surface of the plate. This provides interstices, so that the changes of volume occurring in the chemical reactions of electrolysis may take place without exerting lateral pressure upon the crystals, or otherwise crowding them into a condition of break-up. These crystals are not, of course, mechanically and irregularly bound together, but are related to one another according to the laws of molecular formation, and are, consequently, much more strongly bound together than if they had been mechanically combined.

Furthermore, this crystalline structure presents the maximum obtainable surface for the given mass, an infinite number of inter-crystallic channels passing all through the material and the entire plate being of the same thoroughly spongy consistency, except in those small portions where the continuous lead framing is encountered.

The effect of this extreme porosity and surface area is to give the battery a maximum capacity for a given weight and size of cell, an item of great importance when considered with reference to the demands of traction. Very heavy discharges also can be taken from this battery, owing to the interstices between the crystals permitting changes of volume to occur without mechanical violence to the structure.

While the method of construction just described seems to accomplish its anti-disintegrating function perfectly, it has been thought best by the manufacturers, in order that there shall be no doubt about the matter, to introduce between the plates a thin sheet of acid-proof fabric, so that any small particles which might fall away could not make metallic contact with two adjacent plates and thus short-circuit the cell. The fabric chosen for this purpose is woven asbestos cloth. It might be thought that the introduction of this asbestos would considerably increase the internal resistance of the cell, but the fact is otherwise, the resistance of the cell being not appreciably higher than that of other lead cells.

This is undoubtedly due to the fact that the larger part of the resistance of most lead cells is that caused by poor contact between the lead framing and the paste placed in it. In the chloride battery this contact is exceptionally good, owing to the pastilles of chloride being so firmly bound by the framing cast under pressure as to compensate for any resistance due to the asbestos.

These batteries are, and have been for several years, operating successfully and in very large numbers in the city of Paris as a source of current for lighting purposes. A large plant has been in operation in Philadelphia in the building of the Provident Life and Trust Company for a year past, and a very large one has been installed at the station of the Germantown Electric Light Company, where it is said to have given, thus far, entire satisfaction.

The manufacture of this battery is protected by a large number of patents of the United States and of foreign countries, a list of which is hereto appended.[*] The essential feature of the process of manufacture, however, are covered by the patents granted to Mr. Clement Payen.

Believing that this battery is a noteworthy and meritorious improvement upon many other forms of lead battery, tending to greater durability, greater capacity without increase of weight, and making possible heavier discharges without injury, the Institute, therefore, recommends the award of the John Scott Legacy Premium and Medal to Clement Payen, the inventor.

Adopted at a meeting of the Committee on Science and the Arts, held Wednesday, June 28, 1894.

Joseph M. Wilson, President.
Wm. H. Wahl, Secretary.

Countersigned by

Arthur Beardsley,
Chairman of the Committee on Science and the Arts.

LEGAL NOTES.

The General Electric Construction Company has begun an action at Buffalo, N. Y., to foreclose a mortgage of $44,000 held against the North Main Street and Tonawanda Electric Company and others. The money was borrowed to construct the road and the plaintiff alleges that interest and payments have not been made.

The Western Electric Company of Chicago have applied to the Circuit Court at Millwaukee for the appointment of a receiver for the real estate and property used as an electric light plant at South Milwaukee. The notice is given in connection with a suit begun against William W. Williams and wife and Frederick Pabst. The property in question is mortgaged to the Western Electric Company for $8,800, and the company holds a judgment against it for $9,081.35 The mortgage was executed April 24, 1894, and covers the land, building, boilers, engine and dynamo, as well as the posts and wires used in the electric lighting plant.

An attachment for $25,043 has been served by the sheriff against the Ongley Electric Company, whose office was at No. 1 Broadway, New York, and factory at Hoboken, N. J., in favor of Henry W. Hardon, as assignee to Thomas W. Robertson. The latter was the president and reputed financial backer of the company, and made an assignment in April, 1893. The attachment was served on two banks and a safe deposit company, but no money was found to attach.

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[*] Accessible for reference in the records of the Committee on Science and the Arts.

Duplex Telephony.*

BY T. R. ROSEBRUGH.

In considering this question I propose to do so with reference only to the principles involved, the question of priority of invention of any of these being left untouched.

The name "duplex telephony" though not altogether exact as a description of the methods to which I intend to refer in this paper, is nevertheless very near to the meaning.

It will be as well to consider at the outset how the telephone problem differs from that of the telegraph, for one might naturally suppose that the known method of duplexing telegraphic transmission would be available for the telephone. Actually there is little in common.

The electrical impulses which are used in telegraphy are of definite and predetermined character as to polarity and strength of current while they last, and differ only in their duration and grouping in time, while those of telephony are, of course, from the point of view of the electrician, entirely uncontrollable. Besides this, in telegraphy, at the receiving end the only information really given by the sounder is the interval during which its corresponding key at the transmitting end was raised, or depressed, and this is sufficient; whereas at the receiving station the waves of telephone current must be received in very nearly their original form. This means then of increasing the working capacity of telephone lines is not available, while in ordinary practice in telegraphy the distinction between change of polarity and increase of current doubles the capacity of the line. In the second place, in any system of transmission, telegraphic or telephonic, it is possible so to arrange the circuit that a receiving instrument is shielded from the effect of the transmitter at the same station while responding to that at the distant end. This may be done in several ways, the "bridge" method being most usual; in this method the two wires which enter the station, or the wire and the earth conductor, are connected as though their resistance was to be measured in the usual way, the receiving instrument taking the place of the galvanometer, so that when properly balanced it only responds to the transmitter at the distant end. Three reasons prevent this method from being useful for telephonic purposes: a satisfactory balance would be more difficult to obtain owing to the capacity and self-induction of the line and self-induction in the instruments at the other end; besides this only a fraction of the current would be employed usefully; and probably more important than either of these is the fact that while the telegraph may be used for the continuous transmission of messages in one direction, the telephone is intended essentially for conversation, so that even if a pair of simultaneous transmissions in opposite directions over a line were established, a single conversation would demand the use of both.

The third difference consists in the well-known fact that on account of the sensitiveness of the telephone the circuit in which it is placed must be as nearly neutral as possible to outside influences both electrostatic and electromagnetic, as well as to the direct action of differences of earth potential; and this can only be done by a return metallic conductor traversing practically the same path as the first.

For these reasons, then, it happens that given a single metallic conductor extending between two distant points, with access to an earth connection at both points, used as a telegraph circuit in the ordinary way, four messages may be transmitted simultaneously, yet the same conductor will only suffice for a single conversation in a very unsatisfactory way.

Since two wires are necessary for the proper transmission of one message by telephone it might hastily be assumed that this is a constant ratio, that is that the conductors must always be twice as many as the number of messages that are to be transmitted simultaneously. The fact is, that it is the difference and not the ratio which is constant. There is no doubt, for example, that if it were necessary ten messages could be transmitted simultaneously by eleven conductors without interference, although in that case it is exceedingly doubtful whether the complexity of the system would not preclude its use.

The most natural way of proceeding to increase the transmitting capacity of telephone conductors is to regard the already existing two-wire metallic circuits as the units out of which to construct metallic circuits of a higher order, which I will term derived circuits.

It is necessary then that two points be obtained on a two-wire metallic circuit, satisfying the condition, firstly, that no difference of potential be produced between them by the action of the transmitters already in that circuit, and secondly, that no effect be produced in the receivers of the circuit by the entrance and exit of current at these two points. The first condition may be satisfied in two ways according to the arrangement of the instruments already in circuit. If intermediate transmitting instruments are to be in series they must be divided into two similar parts, one in each line, as in Fig. 1 are D and E, two secondary coils of transmitter T 1, arranged so as to contribute at each instant electromotive force equal and in the same sense with regard to the metallic circuit, and therefore in opposite directions with regard to the line.

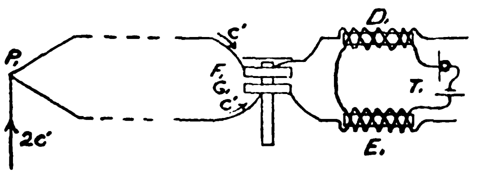

FIG. 1.

If the two sides of the metallic circuit have the same resistance it will be seen that no difference of potential can be produced between the points where the two lines unite, as in Fig. 1 at P 1, and the corresponding point at the other end of the line. If, however, the transmitting instruments are only at the terminals, or are bridged across between the two sides at intermediate stations, as in Fig. 2, no such modification in their structure is necessary, for their action cannot produce any difference of potential between points which are at the middle of any bridges between the lines.

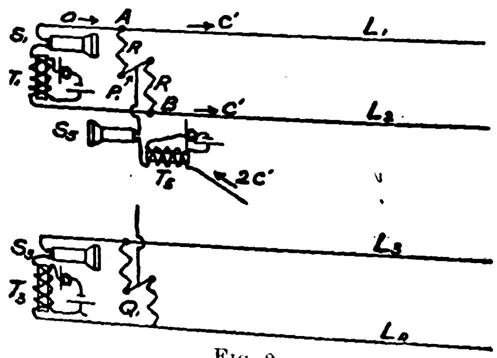

FIG. 2.

It is not true, as might at first be supposed, that every bridge has a middle point, for such a point must divide both the resistance of the bridge and its inductance, if there be any, into two equal parts, and there will not in every case be such a point. In the case of a secondary of a repeating coil it will be necessary also that the two parts have equal mutual inductance with regard to the primary before the point between the two coils satisfies the condition of having the mean potential at every instant.

Since in any case the currents introduced on the lines of the two-wire metallic circuit must divide equally and flow parallel to one another in the same direction, we find the condition that the receiving instruments of the original metallic circuit should not be disturbed by such currents to be, either that the currents should not flow through the coils at all—which may be attained by bridging them between opposite points on the two lines, or, if the introduced current on one line flows through a coil of the receiving instrument, then that on the other line must flow through a coil in the opposite direction, which is just capable of neutralizing the magnetic effect of the first. As for instance in Fig. 1 the introduced current 2c', entering at P 1, divides into two parts c 1, which circulate in opposite directions through the coils F 1 and G 1 of the receiver, and produce no effect, and similarly also in the coils F 2 and G 2 on the same line. Supposing the bridge method selected as being applicable more generally, let us look at the different ways in which it may be carried out. In Fig. 2, L 1 and L 2 are two lines which are supposed to be already in use as a metallic circuit, T 1 and S 1 being the transmitter and receiver at one end and T 2 and S 2 at the other. L 3 and L 4 are similarly two lines of another metallic circuit. Between the points A and B are connected in series two equal non-inductive resistances R. At their common point, P 1, a wire connects through telephonic apparatus T 5 and S 5 with P 2, a similar wire on the same metallic circuit, including also at the second end the telephonic apparatus T 6 and S 6; or it may connect with Q 1, which is a similar connection on the second metallic circuit, and similarly P 2 with Q 2, both connections including telephonic apparatus. Each of these bridges has then a resistance, 2 R, but owing to the line resistance it would generally be incorrect to say that they are equivalent to a single shunt of resistance, R. The current on the derived circuit passes through the coils of each pair of resistances in multiple, and each is therefore equivalent to ½ R. It is to be noted that currents arriving at A and B from P1, on the derived circuit, do not divide at these points as might be supposed, but that portion of the circuit at the end between A and B, including T 1 and S 1, is left entirely dead, since, due to such currents, there is no difference of potential between A and B. The same thing applies also to T 2 and S 2, and to any other telephonic apparatus of this circuit bridged across between L 1 and L 2, which is not provided with an exit at its middle point.

As a first improvement on this construction it may be suggested that a self-inductive resistance would be better than a purely ohmic resistance, if not connected exactly at the ends of the line, for it would partly compensate the effect of electrostatic capacity between the wires.

The next step in advance is to put the two coils R together on the same core as in a telegraph relay, Fig. 3, so that while the leakage current passing from A to B through the two coils in the same direction around the core reinforces the magnetism of the core and experiences consequently a high impedance, that from the derived circuit which enters at P, the middle point, and divides there, passing in opposite directions around the core in the two coils, affects the magnetic circuit comparatively little, and has therefore low impedance. In the case of an ordinary box relay of 150 ohms we would have in series from A to B a resistance of 150 ohms, and an inductance of 4.8 henrys, while from P 1 to A and B in parallel we have 37½ ohms and .49 henry, or to the note "middle C" an impedance of about

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* Read before the Canadian Electrical Association.

7,730 ohms to currents leaking through its coils in series, and 790 to the derived currents dividing from the middle point outwards, making a total impedance of 3,160 ohms in addition to the ohmic resistance of the derived circuit. Better results than this could be obtained by superimposing the windings instead of having them on the separate limbs of the magnetic circuit. The best possible results, however, will be obtained when the derived current forking at P1 to A and B traverses practically identical courses in opposite directions around the magnetic core, and has therefore a non-inductive path, while the leakage current from A to B passes over this course twice in the same direction, experiencing the maximum impedance. This may be accomplished most exactly by twisting the wires together and winding the double conductor on the coil. A coil made in this way, Fig. 4, measured 480 ohms and 4.6 henrys to the leakage current, or an impedance of about 7,400 ohms to the note "middle C," while to the derived current entering at its middle point it was practically a non-inductive resistance of 120 ohms. In good modern construction it is necessary on circuits of moderate length to transpose the wires on the poles, in order to expose them equally to outside disturbing influences. In addition to this transposition, to get the best results it is often desirable to transpose the circuits among themselves; this transposition of the metallic circuits is more necessary when derived circuits are formed from them, for in that case transposition on the poles is as important as it is for single conductors, to which they are then equivalent. For this reason the derived circuit should not be applied to a pair of circuits differing materially in length.

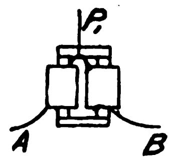

FIG. 3.

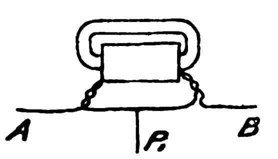

FIG. 4.

The underground cable system connecting stations in the same city affords an excellent opportunity for the application of the above principles, for a large number of metallic circuits between the same two points are in continual demand and are quite expensive. A redistribution of the position of the wires in the cable being made at every manhole the transposition must be quite thorough.

Coils such as are indicated in Fig. 4 have been in use in Toronto for some time on the cable between the main office and the Yorkville station; they afford an extra speaking circuit for each pair to which they are applied, in which as well as in the two original circuits, speech is perfectly transmitted. The same thing is true of a pair of metallic circuits between Toronto and Hamilton, when the circuits are free from long extensions.

It appears quite probable that on very long lines the decreased conductor resistance and self-induction of the derived circuit as compared with the originals would fully counterbalance the increased electrostatic capacity, and give, for example, between New York and Chicago, three speaking circuits for every four conductors, instead of two, the transmission being unimpaired in any of the circuits.

Electrician Gillette, of the Electric Railway Company at Terre Haute, has a cage in the electrical supply room at the power station containing seven mice. The mice are of the ordinary variety, but have an extraordinary manner of enjoying themselves. A large flat wheel has been suspended in the center of the cage which revolves upon a well poised axis. The mice mount this wheel and start its motion by running around the edge. They keep up the sport for hours at a time. They roll over and over one another as the wheel revolves and finally fall off from dizziness. The mice have become so infatuated with the sport that they are ready at any time to take a whirl on the merry-go-round.

Alternating Current Motors.[*]

BY L. M. PINOLET.

The alternating current system possesses many advantages for the transmission and distribution of electrical energy, but until recently has labored under the disadvantage that it could only be employed for lighting, except in a few special cases, as there were no alternating current motors suitable for general use. This drawback has now been overcome, and self-starting alternating current motors of simple construction and high efficiency can be had. As the alternating current system is so extensively used and is so suitable for the long distance transmission of power, these motors have attracted much attention, and it is my intention to explain briefly in this paper the principles of construction and operation of some of the most important types of the motors.

It has been known for a long time that an alternating current dynamo of the ordinary single phase type would run efficiently as a synchronous motor if its armature were supplied with an alternating current and its fields were magnetized by a continuous current. To illustrate the operation of this type of motor, let us take a four pole motor whose armature windings are connected with a source of alternating current and are arranged to produce four poles to correspond with the four poles of the field, two of which are north poles and two south poles. The strength of the magnetic field necessarily varies uniformly in all the armature poles. If at a particular instant one of the poles, be a north pole, the two adjacent ones at right angles to it are south poles. At the next alternation of the exciting current, the first named pole will be a south pole and the two at right angles to it will be north poles, and so on the poles will change for successive alternations of the current. It is thus apparent that the action of the alternating poles of the armature upon the poles of the other element of the motor is at one alternation of the current in a certain direction and at the next alternation is in the opposite direction. The attraction at one alternation is thus neutralized by a repulsion at the succeeding alternation, and consequently the motor will not move. But, if the movable element be rotated in either direction at a synchronous speed with the shifting of the magnetic poles of the armature, the armature poles can be brought into such a position with respect to the field poles that the attractions and repulsions between them are always in the direction in which the motor is running. The motor will then continue to run at a synchronous speed and will stand a considerable overload without being thrown out of step or synchronism. A synchronous motor is usually brought up to speed by a small non-synchronous motor of one of the types described below. When the large synchronous motor is running at the proper speed, it is connected with the line by a switch, and the load is thrown on by a friction clutch.

The difficulty of starting these synchronous motors has rendered them unsuitable for general use, and a number of electricians have worked at the problem of making a self-starting motor for single phase alternating currents.

One of the methods adopted is to provide one of the elements of the motor with two energizing circuits which produce separate sets of poles in the element. The alternating currents in the energizing circuits are caused to differ in phase and thus set up a rotary magnetic field in the element, as in a two-phase motor. The rotary field induces currents in closed-circuit windings on the other element of the motor, which currents cause the motor to run by their action on the rotary field. The difference of phase between the currents in the two emerging circuits can be obtained in one of the following ways.

Both circuits are connected to the same source of alternating current, but the circuits have different coefficients of self-induction, so that the current in one circuit lags behind that in the other. The difference in the self-induction of the two circuits may be obtained by inserting a condenser in one circuit and a self-induction in the other.

One only of the circuits is connected with the source of alternating current. The other circuit is closed on itself and is within the inductive influence of the first circuit. The alternating currents in the first circuit induce currents in the closed circuit which differ in phase from the inducing currents.

In another type of single current motors, the rotary element is provided with normally open circuit coils, whose terminals are connected to a commutator, and the field of the stationary element is excited by an alternating current. By means of brushes, the circuits of the coils are closed when they are in such a position that the magnetic field of the currents induced in the coils by the exciting magnetic field, is assymmetrical with respect to the exciting field. The field of the induced currents is repelled by the exciting field, and thus the movable element of the motor is caused to rotate.

If the movable element of a motor of the above described type be provided with a number of closed circuits, the field of the currents induced in the closed circuits will be symmetrical with the exciting field when the motor is at rest. The repulsions will then be equally strong in both directions, so that the motor will not rotate. But, if the movable element be rotated in either direction, the fields become assymmetrical with respect to each other, and the repulsions are greatest in the direction in which the movable element is rotating, so that it will keep on rotating when started, with a tendency to synchronism. These motors can be started by an extra energizing winding, used only at starting, in which the current is caused to differ in phase from that in the regular energizing circuit by one of the above-described methods. Or the motors can be started without a starting winding, if the circuits of the coils of the rotary element are open and are connected to a commutator. The motor is started in the way already described, by closing by suitable brushes the circuits of the coils when they are in such a position that their magnetic field is assymmetrical with respect to the exciting field, and when the motor has acquired its proper speed the circuits of all the coils are closed. Prof. Elihu Thomson, who has done much to develop motors of this type, says in a recent article that they have attained a fair degree of perfection, though the writer of this paper is not aware that any reliable tests of their efficiency have been published.

Having examined the principal types of single current motors, we will consider the polyphase motors which are self-starting and of an extremely simple construction.

A polyphase motor consists essentially of a rotary and a fixed element, each provided with suitable windings. The windings of one of the elements are supplied with polyphase currents, which consist of two or more separate alternating currents having the same frequencies, but whose phases differ from each other. These currents set up a magnetic field in the element, which field is rotated, or progressively shifted, around the element, by the combined action of the different currents. The rotating field attracts the field produced by currents in the windings of the other element and thus causes the movable element of the motor to rotate. This principle, upon which a polyphase motor operates, is analagous to that of a continuous current motor, for the commutator of a continuous current motor produces a rotation or progressive shifting of the magnetic field of its armature. The attraction between the rotary field of the armature and the stationary field of the field magnets causes the armature to rotate.

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[*] Read before the Canadian Electrical Association, Sept. 19, 1894.

In this paper, in order to avoid the confusion at present existing as to which element of a polyphase motor is the armature and which is the field, the element in which the rotary magnetic field is produced is called the armature, and the other element is called the field.

To illustrate the working of polyphase motors, we will take as an example a two phase motor with a stationary armature provided with two sets of windings. The two windings are supplied with separate alternating currents and produce two pairs of poles at right angles to each other. The two alternating currents have the same frequencies, but one of them lags behind the other by 90 degrees, and therefore the magnetic field of one pair of poles is at its maximum strength when the field of the other pair is at zero, or is neutral. If at any instant a particular pole of the four poles be a north pole, one of the poles at right angles thereto will subsequently become, at the next instant, a north pole. Then, the opposite pole to that first named will be a north pole, one of the poles at right angles thereto will subsequently become, at the next instant, a north pole. Then, the opposite pole to that first named will be a north pole, and at succeeding alternations of the exciting currents the north pole, and necessarily the south pole as well, will be rotated or progressively shifted around the armature in a certain direction. In this way a rotary magnetic field is produced in the armature.

Instead of an armature of this type, the armature may be an ordinary Gramme ring armature, but without a commutator, and the two currents may be supplied the windings at points 90 degrees apart (points 180 degrees apart being connected with the same circuit). The combined action of the two currents will set up a rotating magnetic field in the armature, similar to that produced in the armature of a continuous current motor when running.

If a pivoted copper cylinder be placed inside an armature of either of the above types, in which there is a rotating magnetic field, the rotation of the field will induce currents in the cylinder, which, according to Lenz's law, will be in such a direction as to oppose the movement of the field. This opposition to the rotation of the field will cause the cylinder to rotate. As a copper cylinder would be unsuitable for use as the field of a motor, this element is usually composed of a cylinder of laminated iron mounted on a shaft. The cylinder is provided with copper windings parallel to its axis, which are connected together in a number of closed circuits. The rotary field induces currents in these closed circuits which oppose the rotation of the field, and these currents thus cause the motor to rotate.

The currents induced in the closed circuits are proportional to the number of lines of force of the rotary magnetic field, which cut them in a given time. The number of lines cut is greatest when the motor is at rest, and becomes less as the speed of the motor increases, until synchronous speed is reached, when no lines cut the closed circuits. For example, if the exciting currents have a frequency of 60 periods a second, when the rotary element of the motor is stationary the closed currents are cut 60 times by a north field and 60 times by a south field each second. The number of lines cut thus varies directly as the difference between the speed of the rotary element of the motor and that of the rotary magnetic field, and when there is no difference in speed no lines are cut and no currents are induced in the closed circuits. With no currents in the closed circuits there is no magnetic field to act upon the rotary magnetic field. The motor, therefore, runs at a speed which is less than that of the rotary magnetic field, the difference between the two speeds being called the magnetic slip. The closed circuits have a very small resistance, so that strong currents are induced in them by the cutting of a comparatively small number of lines of force, and the magnetic slip is therefore small. Anyone can easily satisfy himself that the currents induced when the magnetic slip is small will produce a strong torque by exciting the field of a continuous current dynamo or motor and short circuiting the brushes. On turning the armature by hand the torque will be found to be considerable.

In practice the variation in speed of a motor of this type between no load and full load is generally from 3 per cent to 5 per cent. From the foregoing explanations it is evident that if the field of the motor be excited by a continuous current it will rotate synchronously with the rotary field. Synchronous polyphase motors are constructed on this principle and keep in step with the alternations of the exciting alternating currents even if heavily overloaded. They are self-starting, but do not start readily, and for this reason are not capable of such extensive use as the non-synchronous motors, though they have been found to be preferable for large units. We will therefore confine our attention to the non-synchronous motors.

When a non-synchronous motor is running at full speed the alternations of magnetism in the field are few, as already explained, and the hysteresis losses in the iron are correspondingly small, but in the armature the alternations of magnetism and the hysteresis losses remain the same as when the motor is stationary. As the rotary element of the motor contains considerably less iron than the stationary element, the hysteresis losses are decreased and the efficiency of the motor increased by having a rotary armature and a stationary field, so that the most frequent changes of magnetism will take place in the element which has the least iron. But in small motors, and also in large motors where a slight decrease in the efficiency is not of importance, the armature is preferably stationary and the field is rotary, as this arrangement dispenses with collectors and brushes.

The field of a non-synchronous polyphase motor is usually the rotary element of the motor, for then brushes and collectors are not required, as already explained. The field then consists of a laminated iron cylinder mounted on a shaft. A number of stout copper wires or bars are threaded through holes near the periphery of the cylinder and parallel to its axis, or are embedded in slots in the cylinder. By this construction the air gap between the iron of the field and that of the other element of the motor can be made very small, which is essential to efficiency, for if the magnetic resistance of the air gap be not comparatively low a large magnetizing current will be required by the motor. The bars or wires are carefully insulated from the cylinder and are connected together at each end to a copper ring, which joins them together in a common closed circuit, or they are connected together in a number of independent closed circuits. When the field is stationary it usually consists of a cylinder or ring of laminated iron in the center of which is the rotating armature. The windings of the field are arranged and connected together in the same way as when it is rotary, with the exception that the windings are on the inner periphery of the cylinder or ring.

The armature of a polyphase motor is preferably a ring or cylinder of laminated iron somewhat similar to the field core. For, as is apparent from the manner in which the magnetic field rotates around the armature, a ring of iron without projecting pole pieces facilitates the rotation of the field and also avoids injurious reactions caused by the projecting pole pieces. One of the simplest forms of this type of armature is the Gramme ring armature already referred to, which has no commutator and whose windings are supplied with two-phase currents at points 90 degrees apart; points 180 degrees apart being supplied with the same current. The combined action of the two currents sets up a single rotary magnetic field in the armature. The same result is obtained with three-phase currents by supplying the currents to the armature windings at points 120 degrees apart. The drum winding is, however, generally used instead of the Gramme winding, and in this case the windings are connected together by conductors arranged around the ring near its periphery. The windings of this type of armature are imbedded in the iron core in the same way as those of the field, and for the same reason, viz., to reduce the magnetic resistance of the air gap. A ring armature of this type can serve as either the stationary or rotary element of the motor. When it serves as the rotary element the currents are supplied by collectors and brushes.

The armature windings are arranged to produce a greater or less number of poles, according to the speed at which the motor is desired to run. The speed varies directly as the frequency of the exciting currents and inversely as the number of pairs of poles in the armature. For example, if a motor having two pairs of poles be supplied with four pairs the rotary magnetic field will take twice as long as at first to make one revolution, and the speed of the motor will be reduced correspondingly, as it is governed by that of the rotary field. The same result can be accomplished without diminishing the number of poles, by reducing the frequency of the exciting current one-half, which reduces the speed of the rotary field so that it takes twice as long as at first to make one revolution. A motor, therefore, must be adapted to the frequency of the current on which it is to be used, and, in order to have a slow-speed motor without many poles, the frequency must be low. When the speed desired in the motor requires many poles in its field and armature, a stationary armature without projecting poles (similar to the field magnet of a continuous current multipolar dynamo) is generally used instead of the ring type of armature, as it is difficult to get many poles in an armature of the latter type.

The foregoing explanations show that polyphase motors are of an extremely simple construction, consisting only of a rotary and stationary element of laminated iron with suitable windings and usually without sliding contacts or brushes. They possess a number of good qualities, among which the most important is probably the absence of a commutator, which must be used with continuous current motors and which requires much attention and is the source of much trouble. The absence of a commutator practically limits the care and attention required by a polyphase motor to oiling the bearings.

The simplicity of construction insures freedom from repairs as well as facilitates the insulation of the various windings. The closed circuit windings on the field are never subject to an electromotive force of more than a few volts, so that the insulation is not likely to break down. The motors will stand a considerable overload without undue heating, and will also stand considerable abuse without damage. Regarding this point, Dr. Louis Bell, in a recent paper before the American Institute of Electrical Engineers, stated that he had never been able to burn out an armature coil or to seriously injure a polyphase motor by the severest tests.

The non-synchronous motors start with a strong torque and run almost at a constant speed under large variations of load, and compare favorably in these respects with continuous current motors. Tests of polyphase motors of different sizes show that their efficiencies are equal to those of continuous current motors of the same sizes.

It is no wonder that the two-phase and three-phase systems for the transmission and distribution of electrical energy are attracting so much attention when the good qualities of the motors are taken into consideration in conjunction with the fact that by these systems alternating currents can be furnished for light and power, and in addition continuous currents can be supplied by means of rotary transformers. The polyphase system is thus capable of universal application, as from it can be operated any kind of electrical apparatus for either alternating or continuous current and at any voltage.

The Electric Brake in Practice.*—III.

BY ELMER A. SPERRY.

(Concluded.)

From the smoothness of even a sudden stop by the electric brake it seems as though the car was running into an air cushion. It will thus be seen that the brake is automatic and does its work without any special act or even the knowledge of the motorman. He simply "works a single handle" back and forth and electricity "does the rest." Suppose the motorman wishes to stop his car, he turns off the current by simply swinging the lever over to the right. This operation is made to automatically convert the motor into a special dynamo for generating currents at very low speeds, and also simultaneously to cut off all connections with the trolley current. The brakes are then applied by simply swinging the handle back over the path it has just traversed; the farther it is swung to the left the stronger the brakes are applied. The act of releasing or letting off the brakes again automatically re establishes connection with the trolley and reconverts the dynamo into a motor.

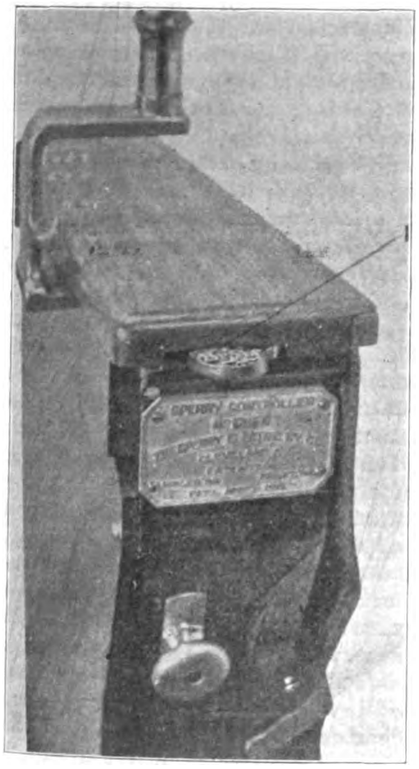

Fig. 11.

Fig 13 shows the switches used in part for the conversion of the motor, and also the finger F mounted upon the lever forming a part of the alternate stroke operating device. The trolley brake-switch B is shown open in Fig. 12. The same rheostat and contacts are applied to control the motor while running the car, and also to control the slight amount of current generated by the transformed dynamo, which is sufficient to brake the train.

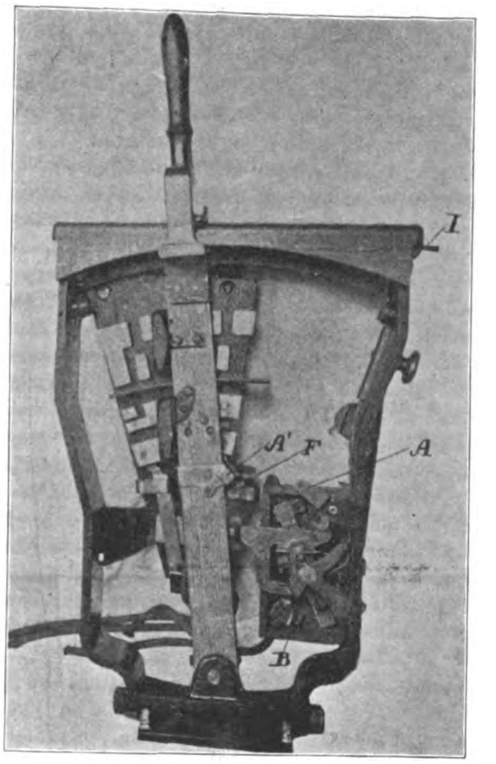

Fig. 12.

The motorman cannot turn on the current before the brakes have been released, nor can he apply the brakes before the current has been turned off. This is a result of construction and constitutes a feature of merit in the new electric brake, effecting an economy in current and a saving in wear and tear. Freeing the conductor of all care in this connection, and leaving the braking of the train—including trailer or trailers and all—solely in the hands of the motorman by placing at his command a power with which he may with the utmost ease accomplish his task, constitutes an important advance in the art of control of electric railway equipment.

It has been found that the electric brake is practically incapable of abuse by any motorman, an advantage which never before has been attained in any power brake, due to the fact above named, that no amount of over-application can cause flattening of the wheels, or any harm whatever to any part of the equipment through their locking and skidding.

The application of the brake, its regulation and also the running of the car, all by a single operating handle, is a result that has only been accomplished by the closest application. The arrangement may be easily seen in Figs. 12 and 13. The various portions of the controller have been subjected to the severest tests possible, one test made in 1893 consisting in 518,700 consecutive brake applications without appreciable wear, the parts being in regular service at the present time. An indicator at the right side of the controller at the top (see I Figs. 12 and 13) shows when the controller is in condition for brake or is being so used.

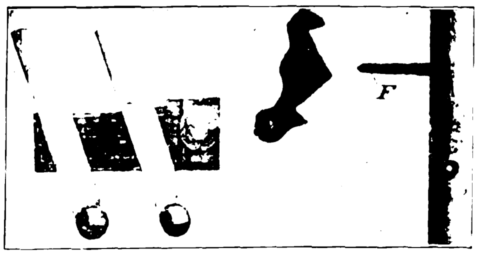

Fig. 13.

Operating the brake in this manner it will at once be seen that the system is one of the utmost certainty of operation, surer even than the hand brake, air or other power brake, from the fact that every time the car runs, the motor, which is depended on for the braking action, receives a test, and its fitness and capacity for the next brake application is constantly being demonstrated. On the other hand, the motorman never knows whether his hand brake is sure to operate when called upon for the next application. An accident came under the observation of the writer on Cass Avenue hill, in Cleveland. Here the last hand brake application was successful in every way, but before the brake was called into action again a nut dropped off from a brake rod upon the truck, rendering the brake useless. The motorman continued to wind on his brake staff, and before he realized what the trouble was his car was going at a tremendous speed into a short curve at the foot of the hill. There were a number of casualties and also six demands for damages as a result. With the air or other power brake this liability to failure is increased in direct proportion to the complexity and number of parts.

The advantages found to result from the practical use of the electric brake as compared with former brake systems; its qualities as an accident preventer, as well as its general commercial value, may be recapitulated as follows:

1. The certainty of its operation.
2. The enormous power at instant command and under perfect control.
3. The absence of all power absorption at moneyed cost from the central station.
4. Its high efficiency, being far superior to compressed air; amply proven in numberless instances where electricity has replaced air. (The air requires a direct application of energy, amounting to an immense aggregate power-absorption during the day from the central station; the working parts of the air machinery are attached to the car axles and require a large quantity of energy, not only while compressing, but at other times as well.)
5. Its extreme simplicity.
6. Observed saving in wheels, two to three fold.
7. Entire saving in brake shoes.
8. Lubrication of brake face; very little wear of either wheel or magnet.
9. Absolute silence of operation and release. (No hissing to frighten horses on streets.)
10. The low E. M. F. at which it operates.
11. The ease of its application and control.
12. Conserving strength and prolonging the usefulness and life of the motormen.
13. The smoothness of its operation.
14. The fact that its use cannot cause flat wheels.

Prof. George M. Minchin, the English astronomer, recently made the announcement that by the use of photo-electric cells, consisting of two metals immersed in a liquid hydrocarbon, and affixed to a telescope in the place of the eyepiece, he had obtained a measurable electromotive force by exposure to starlight alone. The light of Venus gave a force of about one-tenth volt, and that of Sirius one-fifteenth volt. The purpose of the experiment was mainly to ascertain with greater certainty by a most delicate test the relative brightness of stars.

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*Abstract of paper read at the 89th Meeting of the American Institute of Electrical Engineers.

The Chemical Theory of Accumulators.*—I.

BY E. J. WADE.

The reversibility of the primary or ordinary galvanic cell, as embodied in the secondary or storage cell, is but one more example of the universal law of action and reaction. Hardly had the voltaic pile been invented before it was discovered that when at work it developed some resisting or opposing force which tended to choke down the flow of current; and, further, if it were connected to a pair of metal plates or wires dipping into some saline conducting liquid, these latter themselves acquired the power of giving a momentary current after disconnecting from the pile. Gautherot first observed this phenomenon in 1801 while decomposing salt water with wires of silver and platinum. Two years later Ritter obtained the same effects with gold wires, noticed the formation of metallic films and peroxides by electrolytic action and embodied the results of his observations in his secondary pile, which consisted of disks of copper separated by pads moistened with saline solutions, and which, when charged up by a battery composed of a larger number of elements than itself, could give out transitory currents of considerable intensity. These secondary currents were rightly thought to be due to the recombination of the acids and bases set free when the salts were decomposed by the passage of the primary current. Some years later, however, it was observed that similar currents could be obtained from platinum wires which had been used to decompose dilute sulphuric acid, or even pure water, and as in this case the metal was not oxidized, and there were no salts present to be decomposed it was maintained that they must have a physical rather than a chemical origin, and the wires were said to be "polarized" while the phenomenon itself was termed "polarization." During the years that followed numerous investigators were constantly at work on the subject, but nearly all from the same point of view, and with the same object. They regarded polarization effects as of no value in themselves, but studied them in order the better to be able to destroy or reduce them to a minimum and so increase the efficiency of primary cells, and it was during this period that the Daniell, Grove, Bunsen and other constant current batteries were invented. It was conclusively proved, however, that polarization was always due to purely chemical causes, and in the cases just mentioned was caused by the decomposition of the water itself into its constituent gases, which were liberated at either pole, and generated secondary currents during their recombination. Platinum wires, which had been immersed in oxygen and hydrogen gas respectively, gave currents in dilute acid just the same as those which had had a primary current passed through them, and Sir W. Grove constructed his well-known gas battery, which he described in 1842, on this principle. Although Grove set up his battery by the addition of oxygen and hydrogen previously prepared, he could, as he well knew, have energized it equally well by sending a current through it and decomposing the water, and it may be considered, therefore, as the earliest form of reversible battery which was fully recognized as such. In fact, no storage cells of more recent date present the principle on which their action depends in a simpler or more striking form than does this gas cell of Grove, and besides which it embodies some of the chief points that go to the making of a good accumulator in such a complete manner that, although practical difficulties stand in the way of its adaptation commercially, it will always possess a very considerable theoretical interest.

The line of research, however, that it might naturally be thought to have suggested was not followed up, because in those days the need of a cell for the storage of electricity was not felt, and even if one had been invented it could have been of very little use. Primary cells were then the only known source of dynamic electricity on any practical scale, and to have set up a number of these merely to charge a smaller number of accumulators, instead of using them direct for the purpose in view, would obviously only have been a waste of both labor and material.

Gaston Planté was the first to investigate polarization phenomena with a view to their utilization instead of their elimination, and in 1859 he commenced the series of researches which are embodied in his well known work. The experiments he carried out, and the apparatus he employed, were of the very simplest nature. Rods of various metals were in turn placed in a small acid voltameter or electrolytic cell, and a current passed through it from two to three Bunsen cells; then, by means of a simple form of mercury switch, the battery was cut out of the circuit, and the voltameter at once connected to a sensitive galvanometer. In this way he carefully examined the polarization in dilute sulphuric acid of all the ordinary metals and found that every one of them gave secondary currents, although in some instances very slight and transitory; but that those obtained with led electrodes far exceeded the others both in duration and intensity.

Guided by this observation, he then constructed his famous spiral form of lead accumulator; investigated the best method of "formation" for increasing its capacity, and utilized a number of such cells to carry out a variety of experiments on the heating and other effects of very large currents, which it would have been almost impossible to obtain without their aid. His book should be carefully read by everyone interested in the subject, not only on account of its suggestiveness and the information it contains, but also as an example of the results that may be obtained from the minute and accurate observation of the simplest phenomena, and of the thorough way in which scientific research should be conducted. Although, owing to the limitations of electro-chemical knowledge at that date his explanations of some of his experiments were necessarily incorrect, later investigations have never, in the smallest particular, impugned the accuracy of his experiments and observations themselves, while many of the points to which he drew attention have only been rediscovered in quite recent years. He noticed the evolution of oxygen from the peroxide pole on breaking the charging circuit; the formation of peroxide at the spongy lead pole when discharged; the presence of unstable compounds (peroxide of hydrogen and persulphuric acid) in the electrolyte; and he further remarked that these latter were produced in greater abundance with lead than with platinum electrodes. Even yet, however, the time was not ripe for the commercial development of the storage cell, and no further advances were made in this direction for some years; but, as soon as the evolution of the dynamo-electric machine reached such a stage as to render the production of large currents at high E. M. F.'s a comparatively easy and inexpensive matter, interest in the subject was revived. In 1881 Faure took out his patent for preparing the active material of lead plates from a paste of oxides applied to their surface in order to obviate Planté's long and worrisome process of formation from the electrodes themselves, and the modern history of the accumulator may be said to commence from that date. Since then no alteration in principle has taken place, although the cells have been enormously modified as regards the details of design, construction and management, so as to render them far more durable and efficient. At first the "pasted" cell was considered to be in every way an advance on the earlier "formed" type, and was for a time employed almost exclusively, but latterly improved forms of Planté's cells have come into very considerable use, together with a third class, in which the active material is prepared independently by special processes, not only from oxides, but from chloride and other salts of lead, and is then used either alone or with a supporting and conducting frame cast round it; and nowadays all three kinds very fairly divide the honors between them.

The interest and avidity with which the Faure cell was received and taken up caused inventors to turn their attention to the construction of accumulators with electrodes of other metals than lead, for it was perceived that these offered greater possibilities as regards the amount of energy that could be stored for a given weight of metal. Sutton's copper-lead cell, Reynier's zinc lead cell, and the Thomson-Houston zinc copper cell are amongst some of the earliest forms of the different combinations tried, and the problem has been again and again attacked, but with such little success that the present day, with the exception of the Waddell-Entz zinc copper cells on the Third Avenue tramcars, New York, none but lead-lead peroxide cells are in practical use, and the mere term "accumulator" or "storage cell" is tacitly understood to imply this combination, unless specially qualified, the others being regarded by the majority as but little more than electrical curiosities.

The sharp distinctions thus made between lead storage cells and all others, whether primary or secondary, has given rise to a very general notion amongst those who have not specially studied the subject that there must be some fundamental difference in their principles of action by which this may be accounted for, and it is worth while, therefore, endeavoring to show that this impression is an erroneous one and not at all in accordance with the real facts of the case.

Theoretically, there is no difference between a storage or secondary cell and a primary cell; both are apparatus for the conversion of chemical into electrical energy. The use of lead peroxide as a depolarizer was known to Faraday and others long before Planté prepared it electrically, and if some chemically prepared peroxide is packed round a plate or rod of lead, and put in dilute sulphuric acid with another plate or rod of lead, surrounded with porous or spongy metal that has not been allowed to oxidize, the combination forms what would ordinarily be termed a primary cell; but one having the same properties as any lead accumulator, whether of the Planté or Faure type. On the other hand, if, instead of putting fresh materials into an exhausted Daniell cell, a current is passed through it in the reverse direction, it forms a Thomson-Houston accumulator; if an exhausted Leland-Chaperon cell is treated in the same way it becomes the germ of the storage cell of Desmazures and many others, and as has been shown above, the Grove gas cell is a primary or secondary cell, according to the way in which it is set up. In reality, therefore, every secondary cell is a possible primary cell, and every primary cell a possible secondary cell. Even a Grove or Bunsen cell might be recharged electrically if special appliances were provided to collect and retain the fumes or gases that escape during the discharge; and Planté showed that every one of his combinations gave some signs, however slight, of secondary currents. The whole question resolves itself into one of the degree of practical reversibility—whether it is possible, by passing a current in the opposite direction, to exactly reverse the changes that took place while discharging and restore a cell to the same conditions both chemically and physically that it occupied at first, or whether it is easier to re-energize it by removing the spent materials and substituting others in their place. Here, then, lies the superiority of a lead-lead peroxide cell to all others. If properly treated it may be regenerated electrically and so nearly restored to its original chemical and physical state that it can be discharged and charged in this way hundreds or even thousands of times before the total results of the slight changes that do take place depreciate it sufficiently to incapacitate it from further use; while with all other cells the changes that occur with each charging are relatively so large that although every possible means has been tried to reduce them to a minimum, they rapidly deteriorate, and require constant attention and repairs. The reason for the more complete reversibility of a lead cell is entirely due to the chemical behavior of certain of the compounds into which that metal enters. Lead alone amongst all the metals forms a sulphate that is practically insoluble and unacted upon in water or dilute sulphuric acid, and it also combines with oxygen to form a peroxide having a good electrical conductivity and equally unaffected by those liquids. When, therefore, a lead-lead peroxide couple is discharged in dilute sulphuric acid, the lead sulphate, which is the ultimate product formed at both poles, does not dissolve up in the solution, but remains on the surfaces of the plates ready for reduction and reoxidation when the current is reversed. Any local action that goes on when the cell is not at work also results in this insoluble sulphate, which tends to form a protecting film on the metal, and thus reduces losses from this cause to a minimum. The compounds formed when any metals other than lead are used as negatives--not necessarily in sulphuric acid, but in any other practically possible electrolyte—are all soluble, and dissolve in the liquid as fast as they are formed, and this simple fact has up to the present barred the way to any substantial progress with these classes of reversible cells.

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* From *The Electrician*, London.

Without going into the details of the difficulties that have to be met it is sufficient to point out that up to the present, and in spite of the numerous devices that have been tried, it appears almost impossible, firstly, to redeposit the metal either completely or in an efficient condition, and, secondly, to prevent a very serious amount of local action, because fresh surfaces of the metal are constantly exposed as the first portions dissolve up. If, however, these obstacles in the way of further progress can be successfully removed, and there is no fundamental reason why this should not be done, the use of lead for the negatives, at any rate, of storage cells would, in all probability, become a thing of the past; for, as regards its electrical behavior, there is a good deal to be said against that metal, both theoretically and practically, as is suggested by the fact that it is hardly ever employed in primary cells.

Theoretically the amount of energy that one pound of lead would generate, if wholly converted into lead sulphate, could be produced by about one fourth pound of zinc or iron, or about one-half pound of copper, in spite of the electro-negative character of the latter metal. Practically, the very property of lead, which at present constitutes its superiority to other metals—that is, the insolubility of its sulphate—at the same time seriously limits its efficiency by reducing the energy actually obtainable per pound of metal to a small fraction of the amount theoretically possible. In the first place, the active material requires a grid, or support, of inactive material, which, even in the best forms of pasted cells, will weigh as much as itself, and in Planté cells may be many times its own weight. Secondly, under the best conditions, not more than half the active material is really acted upon, unless the cell is run down below the normal limits, because the sulphate formed on its surface effectually screens the inner portions. The combined effect of these two causes is that not more than 5 per cent. to 15 per cent. of the total weight of electrodes is usefully employed; or, say, one ounce to two ounces per pound of plates.

(*To be continued.*)

Effects of Lightning.

Mr. T. W. Carmalt Jones writes as follows to the London *Lancet*: "By the same post I am sending you the skin of a rabbit, which has simply been rubbed over inside with table salt. When we, a party of five, were at lunch in the keeper's cottage in Kingswood, near Woodstock, this afternoon, there was some thunder about. About a quarter past two there was a tremendous crash with a blaze of light—the light reddish, certainly not blue—and we all felt more or less shaken, and were certain that the lightning had struck somewhere very near us. We soon found that a tree 35 yards from the cottage had been struck. The bark had been ripped off the tree in two streaks, between 2 inches and 3 inches wide, and some of it was hanging in strips from the tree, and pieces of bark in small pieces and in strips were lying for a distance of at least 10 yards all round the tree. The tree was a larch, and the tallest near us, and was estimated by an architect and a builder, who were of our party, to be at from 55 feet to 60 feet in height. At the foot of the tree, about 1 foot from its base, we found a rabbit lying dead. It is the skin of this rabbit that I am sending you. You will see where the electricity has scorched off the fur, and we all noticed that there was a distinct smell of burning about the rabbit. The latter was quite warm and limp and lying on its side, the eyes being open and quite bright." The following is the editorial comment on this subject: "The letter of Mr. Carmalt Jones, which is printed in another column, though it does not seem to present any absolutely new feature in connection with occurrences of the kind in question, is interesting in more ways than one——chiefly, perhaps, from the point of view of the rabbit. The 'skin' sent to us shows a space of about 6 inches in length and about 1 inch in width denuded of fur. The bare skin is slightly desiccated, but not discolored, vesicated or charred. It is presumed that there was no further sign of injury or disorganization of tissue in the rest of the body of the animal. This is consistent with the known fact that electric discharges even when fatal do not necessarily kill by producing any gross change in the tissue and organs, or even, so far as is known, by altering the histological elements of a structure. The damage to the tree is simply the disruptive effect of the lightning flash striking an imperfect conductor. The men 'felt more or less shaken.' In other words, they experienced a shock due to induction. Owing to the presence of a 'charged conductor' in their neighborhood a charge of opposite sign had been induced in them. When the flash occurred—i. e., when the conductor was discharged--the induced charge in their bodies was also suddenly discharged. This is known as 'return shock.' The distance recorded in this case is not too great for such effects to be experienced. It was very different in the recent balloon accident at Aldershot, where four men holding a captive balloon by a wire rope were 'struck' and seriously injured. In this case the unfortunate men had by means of their balloon simply angled for the lightning, and having captured it, offered it a ready route to earth through their own bodies. It is a source of astonishment as well as of regret that, in the light of historic experiments with lightning and kites, such an accident as this should not have been foreseen and provided against."

New York Electrical Society.

Members of the above society are invited to meet at the East 33rd St. Pier on Thursday, Oct. 11, whence a special steamboat will leave at 2:30 P. M. for Riker's Island. An opportunity will be given to inspect the electro-disinfecting plant located there.

Portative Electricity.

A correspondent of *Industries and Iron*, Mr. R. W. Hill, of Manchester, sends, under the title of "Portative Electricity," an amusing letter respecting an electrical means he has devised as a defence against larcenous depredations from the person. After relating by what means he was bereaved of a valuable personal ornament, Mr. Hill recounts the measures he has sagaciously devised to meet any future contingencies of the same nature. "I rigged up," says he, "a small contact for my scarf pin, bought a tiny electric bell (patented Nov. 9, 1886, and Nov. 27, 1888), made a double pocket accumulator, and am now ready for any emergency.

"I may say that I now carry about with me a whole electric museum. The source of electric energy is stored up in said accumulators, and I have made a contact for my watch; thus, if any attempt is made to extract it quietly, the tell-tale indicates the fact at once. The third item of my equipment is a tiny incandescent lamp concealed in a well finished artificial waterproof flower pinned to my coat. The lamp is useful during a performance at a theatre when the light in the house is usually lowered, and when I may desire to look at the programme, etc. Another piece of apparatus, invaluable to an inveterate smoker, as I am, consists of a very fine platinum coil placed in a cavity made of asbestos. By inclining the little glass tube the mercury in the same closes the circuit of my pocket battery, and I can thus light my cigar, etc., regardless of the weather. The entire museum weighs about twenty-two ounces, and the only bother is the recharging of the battery. The latest addition to my store is a hollow cane fitted with a tiny lamp provided with a small silvered reflector concealed in the knob. The hollow cane is sealed at the bottom by a rubber stopper, and the exciting fluid is a mixture of chromic and hydrochloric acids. The cell consists of an amalgamated zinc rod and a strip of platinum foil. This type of battery was used for Tissandier's 'navigable' balloon. By inclining the cane the lamp is, of course, fed by an electric current, and gives a good light. Any intelligent person can rig up my portative museum in a few hours."

A Big Electrical Transmission Scheme at Omaha.

The County Commissioners of Douglas County, Nebraska, in which Omaha is situated, have decided to submit a proposition to vote a $1,000,000 subsidy to a company for the construction of a canal to create a great water power just outside of Omaha to be brought into the city in the shape of electrical energy and to be sold at a uniform price to all factories. The rates will be on the average cheaper than the charge for water power in Minneapolis and other water power centres. The water is to be procured from the Platte river, forty miles from Omaha, and from the Elkhorn river, twenty miles from Omaha, will be carried through a canal to a point near the city limits, where a fall amounting to 135 feet will be secured. At this point there will be developed 24,000 horse power. At this point, also, an electrical plant will be established and the electric power developed will be brought into Omaha and distributed to various parts of the city for operating motors. The people of Omaha are expected to vote these bonds by a large majority. The whole enterprise will cost $4,000,000, and the company undertaking it is composed of the richest men in Nebraska.

Inverted Arc Lights.

An attempt has been made to light factory shops in Pawtucket, R. I., by Mr. D. C. Goff, by inverted arc lamps, and the Providence *Journal* gives the following account of the experiment at the Goff Braid Mill with this system :

"It consists in throwing the light from the arc lamps upon the ceiling, which, if white, diffuses it evenly throughout the room. Shadows are eliminated and the light is steady and agreeable to the eye. Mr. Goff was so well pleased with the preliminary tests that he invited a number of electricians and manufacturers to call during the evening while the braiding machines were in operation.

"After inspecting the power room, within sound of Pawtucket Falls, where the electric light machines are driven by water power, the party, accompanied by Mr. Goff, went to the braiding room in the Globe mill. Upon entering, the first impression was that the room was quite dark. This was not the case, however, although there were only seven lights for a floor 50 feet wide and 200 feet long.

"Picking up papers the visitors were surprised at the distinctness of the type. Better light for reading could hardly be desired. The longer one stayed the more favorable was the opinion of the light. There was no glare, which is one of the objections to the arc lamp as ordinarily used, the light was perfectly steady and was not trying to the eye after the first thought of semi-darkness wore away.

"Each lamp had under it a reflector, in form not unlike an umbrella turned upside-down. Directly overhead there was an intense light on the white ceiling, but it was reflected downward so uniformly that the eyes of those at the machines were not affected in the slightest degree, and unless one looked above he would not be aware of any unusual brightness over his head.

"The room, of course, was an ideal one for lighting. There were no columns and only a few belts near the west wall."

Mr. Goff noticed this method of factory lighting while in Europe, and being impressed with its value imported several English lamps which, however, were found to be too expensive for general use. The ordinary style of arc lamp was then substituted and the results were found to be quite as satisfactory and the cost considerably less.

An American Electric Locomotive Building in England.

An electric locomotive of 1,000 horse power is under construction in London, from the plans of Sprague, Duncan & Hutchinson of this city, to the order of the North American Company. It is intended for slow speed and heavy traction in switching service. The machine is carried upon four pairs of driving wheels, all coupled. The frame is of steel, with deep pedestals. The four motors all form parts of a complete system on a rigid wheel base of 15 feet. The motors are of the alternating type, are wound for 860 volts at 225 revolutions, and a speed of thirty-five miles an hour is expected.

A Single Sentence.

A recent issue of the Troy *Budget* contains this item :

"An experienced traveler says : 'This is the strongest single sentence I ever saw printed in a railroad advertisement that I believed to be absolutely true :

"'For the excellence of its tracks, the speed of its trains, the safety and comfort of its patrons, the loveliness and variety of its scenery, the number and importance of its cities, and the uniformly correct character of its service, the New York Central and Hudson River Railroad is not surpassed by any similar institution on either side of the Atlantic.'"

TELEPHONE SERVICE FOR THE MASSES.

A Solid Company Established to Supply Magneto Instruments.

A company has been established, with offices in the Produce Exchange Building, this city, which has in view the renting of telephones at two dollars a month, at which figure it is claimed a first class service can be assured. The instrument to be used is some modification of the magneto telephone, the details of which have not been published.

An officer of the company is quoted by the New York *Herald* as follows :

"We can be sure of giving this cheap service for several reasons. In the first place, our telephone is a very cheap one, planned with the special object of avoiding outlay. In the second place, it is cheap to run. There are no batteries to buy and keep up. Again, the mechanism is of the simplest possible character and not easy to disarrange, so repairs will be light. Then we do not infringe to the slightest possible degree upon anybody's patent, and have no money to spend in lawsuits. Then, again, we are not going to charge high prices for territorial rights, as the Bell company does. We shall give territorial rights free to responsible persons who will form local companies, so these companies will not be compelled to earn interest upon capital not engaged in making money for them.

"So you see, as we are not anxious to get rich all in a minute, we are in a position to put rentals at two dollars a month and keep them there—and still make reasonable profits for ourselves and our local companies."

Another part of this business will be the selling outright of small telephones for private lines, and the instruments being so simple they can be sold at a very moderate price.

In the present state of the telephone patents it will be seen that no obstacle is in the way of manufacturing the transmitting and receiving instruments—there are already quite a number in the market for sale; but a part of the telephone system not less essential to an exchange than the telephones themselves is the switchboard and central station appliances that have been gradually perfected by the Bell Company, who still holds many patents on such devices having yet many years to run. It is undoubtedly upon these patents in connection with its large established business that the Bell Company depends to continue its present monopoly and unreasonable prices. No particulars of this part of the new company's project have reached us, and as this is the essential feature for a good telephone service it is impossible to express any opinion on the proposed business. Any new company will be badly handicapped for some time after starting, as its service will be of comparatively little value until a large number of subscribers are secured, but if a reasonably good service can be supplied at the rate of two dollars per month there is no question that a very large business can be built up very speedily, especially in New York City, where the highest rent in the country is paid for a very indifferent service.

The Lighting of the Bridge Cars.

At the meeting of the Trustees of the Brooklyn Bridge on October 2, Superintendent Martin recommended awarding the job to the Electrical and Mechanical Trading Company, informal propositions only having been received.

Mr. E. V. Skinner made an effective objection, insisting that bids should be advertised for in the regular way. This was the plan finally adopted, and proposals will be received up to October 15.

CURRENT ITEMS.

The Essick "ticker," a new device, records its information in a way differing from that of the "ticker" now in general use, in that the news is printed on a fair sized sheet, looking like typewritten copy, instead of on a narrow paper tape. The operation of the new apparatus at the transmission office is thus described : A young woman sits at a keyboard exactly like that to be found in the ordinary typewriter. This is electrically connected with the "tickers," each of which has a metal wheel bearing the letters of the alphabet, numerals, etc. When the young woman at the transmitter thumps the letter A, or any other letter, the wheel, which is inked automatically, promptly prints that letter on the white roll. And so it continues, the lines being printed as they are to be read, from left to right, as in a newspaper. The shifting of the paper is done automatically, and one person, the one who plays on the keyboard at headquarters, operates all the "tickers" simultaneously. They may number a thousand and some of them may be twenty miles or more away, but all record the events of the day at one and the same moment. The machine is about four feet high and occupies floor space about a foot square.

The Athens (Ga.) *Banner*, without the least sign of incredulity, relates the following : "Yesterday morning a gentleman was walking down town when he noticed a large toad frog hop up to the street car track and put his mouth against the rail, at the same time connecting his feet with the zinc ground connection in such a manner that small electric sparks were generated in front of him and disappeared in a chain of small sparks down his mouth. The frog became so intent with his novel work that he did not perceive an approaching car, or maybe he had developed such an insatiable appetite for electricity that he had concluded to swallow the entire system, cars and all. However, no matter what was the intention of the frog, the heavy wheels of the car ran right over his body, with hardly any noticeable effect to the passengers, except that peculiar effect of recently generated ozone that is the immediate after-effect of an electrical discharge. But the question of what happened to the frog is of more interest than what happened to the passengers. The person who had noticed this peculiar frog walked over to the spot to investigate the matter, and not finding anything, supposed that the motor being of an opposite electricity had picked up the frog bodily. Upon lifting the boards in the car the frog was seen perched up on the motor trying his blandest to suck the heavily charged machine dry."

A strange precaution was taken by Richard Ellicott of West Chester, Pa., to provide means with which to announce his expected return to life. Failing to arouse from death after three weeks, his body was to stay laid in the grave. Ellicott was a wealthy citizen. He suffered from dropsy, and died on Aug. 17. He had always entertained the horror that he might be buried alive. A few days before his death he told his friends of his fear, and requested them to carry out the plans which he then made known. His body was placed in a casket, inside of which was located an electric button. The button was placed near where his right hand lay. A wire was attached to the button, and it connected with an electric bell placed in the sexton's house. Ellicott said his body should lie in the cemetery vault for three weeks. If he came to life during this period he would touch the button and ring up the sexton. He said if he had not come out of the eternal sleep in three weeks his remains should be removed from the vault and consigned to the grave. The three weeks expired ; there had been no signs of returning life. The electric bell in the sexton's home had not been rung.

Boston Notes.

An appalling mishap occurred in Boston Thursday morning about 9 o'clock by which two men, an inspector and a trimmer, in the employ of the Boston Electric Light Company lost their lives. It was a rainy morning and the trimmer ascended an iron pole, corner of Franklin and Congress streets, to trim an arc lamp. As was subsequently discovered, he omitted to turn the switch before changing the carbons. On reaching the top of the pole he secured himself by the straps and hooks provided for that purpose to the supporting arm of the lamp. Directly he touched the lamp he received a shock which apparently killed him instantly. His body hung by the hooks until the current could be shut off at the central station. Meantime an inspector came along and at once climbed the pole with a pair of insulated pincers to cut the wires. By some means he too received a shock and was hurled to the pavement, receiving a fractured skull, which caused his death in a short time. Of course the mishap created great excitement and a crowd quickly gathered. Ordinarily there is no current on the street circuits during the day time, but a close examination of all wires between the point where the men were killed and the central station disclosed the fact that a cross and consequent leakage existed between the street circuit and a commercial circuit which is run during the day time. This charged the street lamp circuit and caused the trouble. The occurrence has emphasized the public demand for all electric wires to go underground, which work is progressing rapidly under the ordinance recently promulgated.

One of the most attractive electrical resorts in Boston is now the handsome offices and showrooms of the Fort Wayne Electrical Corporation on Federal street, near the Postoffice Building. There is a constant stream of spectators and visitors to examine, admire and purchase some of the apparatus that has just been placed on exhibit. It is a place where business men most do congregate, for the gentleman in charge is Mr. E. I. Garfield, who is already making things go with a rush that reminds his innumerable friends of olden times when, stripped down to his "biled shirt," he worked night and day to help build up the Thomson-Houston Electric Company in that phenomenal manner which caused it to be regarded as the wonder of the age. Mr. Garfield has surrounded himself with a staff of salesmen who in past years have proved themselves to be as wide-awake and successful, if not a little more so, as any men in the electrical business; hence it goes without saying that things are destined to be lively ere long, and the high grade apparatus manufactured by the Fort Wayne Electric Corporation is bound to find speedy favor throughout New England.

The Lynn and Boston Railroad Company have for some time past suspected that they were being defrauded in some way by parties conversant with their business and apparently having access to their ticket and fare department. After carefully watching, to see if the leakage could not be discovered, they caused several of their employes to be arrested, with the result that it has been found that quite a rushing trade has been done in purloining books of tickets and selling them to certain conductors. By this means it is estimated the company has lost something like $1,000. Some interesting, not to say startling, disclosures are expected when the men under arrest are placed on trial.

A contemporary has made the announcement that the deadly trolley wires are all to be forthwith buried under the streets of Boston. This is not strictly true, the writer of said paragraph having got mixed between the trolley and feeder wires. These latter are to be buried and pretty quick, too. In the direction of accomplishing this it may here be stated that Mr. F. B. Parsons, of the Norwich Insulated Wire Company, has closed a contract with the West End Railroad for the supply of some thirty miles of cable and conduits to be delivered at once, and as fast as delivered to be buried, between now and January 1, 1895.

General News.

What is Going on in the Electrical World.

Plymouth, N. H.—A long distance telephone service is to be established here.

Albert Lea, Minn.—The city council has decided to advertise for bids for putting in an electric light plant.

Gardiner, Me.—The water power at West Gardiner has been secured by Hallowell parties, who will establish an electric power station there.

Waukesha, Wis.—Nearly enough money has been subscribed for the Waukesha Beach electric railroad, and work will begin on it at once.

East St. Louis, Ill.—The Citizens' Electrical Supply Company of this city has certified to a dissolution of organization and made surrender of charter.

Brenham, Tex.—The electric light company has ordered $2,000 worth of new machinery, the plant now in use being too small to supply the demand.

Pittsburg, Pa.—The quarterly dividend of the Westinghouse Electric and Manufacturing Company preferred stock, 1¾ per cent. (37½ cents per share), was paid here on October 1.

Saginaw, Mich.—Isaac Bearinger, the local millionaire, who has been advocating the construction of an electric railway line between Bay City and Saginaw, says the project will be pushed through next year.

Summit, N. J.—A new company composed of representative citizens is being organized here and will apply to the township committee for an electric lighting franchise. The capital stock of the new company will be $30,000.

Peoria, Ill.—The board of supervisors have appointed a committee to look after the establishing of an electric light plant for county purposes. They will advertise for bids as soon as the plans and specifications are prepared.

Sherman, Tex.—The College Park Electric Belt Line with its two additions has passed into the hands of a Houston and Boston syndicate, the consideration being $50,000. The new company will build ten miles of additional road.

Albany, N. Y.—The *Argus* states that a director of the Consolidated Car Heating Company says its electric heaters have brought it a large new business. Steam heaters only were manufactured by the company until recently.

Grand Rapids, Mich.—The council has voted to bond the city for $150,000 for the construction of a street lighting plant to be owned and operated by the city. Mayor Fisher has addressed a letter to the common council vetoing the ordinance.

Milwaukee, Wis.—A somewhat mysterious patent suit is in progress here between the Edison Electric Light Co. of N. Y. and the Milwaukee Arc Light and Power Co. The clerk of the court refuses particulars, and a collusive suit is suspected.

Perth Amboy, N. J.—The Perth Amboy Mutual Telephone Company, having been granted a franchise, has organized by the election of W. H. McCormick as president, Conrad F. Hall as vice-president, S. R. Farrington as treasurer and J. V. Langan as secretary.

Toledo, O.—It is believed here that a scheme is on foot to consolidate the Toledo Consolidated Street Railway Company, the Toledo Electric Street Railway Company, the Western Electric Company and the Toledo Electric Lighting Company into one corporation.

Lynn, Mass.—Sampson & Allen, electrical engineers, of this city, have recently closed a contract for a large isolated electric light plant in a New Hampshire shoe factory. This plant is to be equipped with the Lundell dynamo, and the power will be furnished by a large water wheel.

Kalamazoo, Mich.—The city council finding that the injunction secured against it preventing a contract being made for a municipal electric lighting plant is based on ground that is solid and cannot be overcome, have voted to again submit the question, and also that of issuing bonds, to the people in November.

Gloucester, N. J.—The United Electric Improvement Company, which has been located at Gloucester City for about five years, engaged in the manufacture of electric dynamos, electric lights and electrical machinery, is removing its plant to Nineteenth and Allegheny avenue, Philadelphia.

Ballston, N. Y.—A syndicate, at the head of which are Stephen C. Medbury, county treasurer, and H. Westcott, has obtained a franchise from the Milton town board to run a trolley road to Rock City Falls, on the direct route to Saratoga Springs, which is the objective point of the line.

Jamaica, L. I.—The village trustees here have voted a franchise to the Long Island Electric Railroad Company. The president is A. R. Hart and attorney Jere Wernberg. It is understood this company contemplates building a line from the Brooklyn City line terminus of the Kings County Elevated Railroad to Rockaway Beach and other points on Long Island.

Philadelphia.—The Mutual Automatic Telephone Company has applied to the Board of Highway Supervisors for permission to lay telephone conduits in nearly all the important streets of the city. An ordinance granting this company the privilege of laying conduits and maintaining a telephone service in this city was approved by the mayor on July 2 last.

Toronto, Can.—In his report to the city council on the bids for the civic electric lighting plant, the city engineer recommends the acceptance of those tendered by the Brush Electric Company of Cleveland, O., for twelve 125 arc light dynamos ($27,201) and for 1,300 double carbon arc lamps ($23,900). The bids of the Brush Company were the lowest of the six tendered on both dynamos and lamps.

Manitou, Col.—Some further plans to build an electric street railway in Manitou are at hand. Grounds for the power house have been purchased and ample funds have been secured. The officers of the company are as follows: President, M. A. Leddy; vice-president, John Hulbert; secretary and treasurer, H. S. Cable; directors, M. A. Leddy, John Hulbert, H. S. Cable, P. S. King, and Ralph Freeland.

Meridian, Miss.—The Meridian Gas Light Company has awarded the contract for the erection of an electric light plant to Contractor C. M. Rubush, of this city. One of the projectors of the enterprise says that the plant, which is to be built at once, will be a great deal larger than the one destroyed by fire several months ago, and that the machinery will be the best that can be purchased for money.

Boston.—The *Traveller* says: "It is stated that a plan is incubating among the prominent street railway men, which for magnitude has not been equalled, and that a great electric railway combination is afoot. Meetings with reference to it have been held—one of them last week in New York—and Chicago, New York and Philadelphia had representatives at these meetings. Important developments may be looked for almost any moment."

New Orleans, La.—The Traction Company has had to withdraw its trolley cars on all of its street lines and reinstate the mules, owing to the inability of the Louisiana Electric Light Company, with which it has a contract, to furnish sufficient power with its present equipment to propel the cars. The light company will make some additions to its plant and try it again, but the newspapers are asking why the Traction Company does not itself establish a plant.

Asbury Park, N. J.—Work is about to begin on the electric railway which will connect Asbury Park with Branchport. With the opening of the line Asbury Park will have an important connection by steamers for freight and passengers to and from New York. It is said that passengers will be carried to and from Asbury Park to New York and return for $1. J. C. Shafer, president of the Asbury Park Electric Railway Company, is backing the scheme.

Allegheny, Pa.—The Westinghouse Electric and Manufacturing Company has built a 14-pot glass furnace on Lacock street, this city, and is going into the business of incandescent lamp making on an extensive scale. The Westinghouse Company is experimenting on ornamental designs of incandescent lamps, and has perfected several novelties which will be introduced shortly. The plant now being erected in Allegheny is 165x85, and is equipped with gas producers and the very best known appliances. It will have a capacity of 20,000 lamps a day.

Ironton, O.—A company is to be organized here to purchase the Ironton and Petersburg

Street Railway, a horse-power line, and convert it into an electric road. A number of prominent Canton men, among them President H. A. Marting of the Eagle Iron and Steel Works; R. Mather, cashier of the Second National Bank; D. Davies and Aaron Winters, merchants; Attorney A. R. Johnson, T. J. Mulligan and others have taken stock in the new venture.

Denver, Col.—The *Rocky Mountain News* thinks that the "installation at the State School of Mines of the most complete electrical plant in the western portion of the country, the very valuable experiments in San Miguel County and the proposed transmission of electrical power from Clear Creek in Jefferson County to the mines and mills in Black Hawk and Central, all point to the extensive use of electricity in mining, to say nothing of this agent in the treatment of ores."

Port Byron, N. Y.—The electric road from Port Byron to Auburn, which has been talked of for a number of years, now seems to be an assured fact. Eastern capitalists have taken hold of the matter, have looked over the route and are well pleased with the outlook. The consent of the property owners along the entire distance, with few exceptions, has been obtained. The road will follow the highway from Port Byron to Auburn. Work will probably be begun early in the spring.

Los Angeles, Cal.—The Electric Power Company, recently incorporated here, was organized for the purpose of acquiring water rights in the mountains north of this city and utilizing the water power to drive dynamos and develop electric energy to be conveyed to this city and other places for heat, light and power purposes. It is understood the plant will be located about thirty miles north of Los Angeles. The projectors have already dug ditches, ordered machinery and done other preliminary work.

Lancaster, Pa.—Anthony Iske, of this place, well known for nearly half a century as an inventor, has invented what is called a "trolley break," and a test just made of it by the Pennsylvania Traction Company is said to demonstrate that by its use the deadly trolley wire, when accidentally broken, is dangerous no longer, as the invention cuts off the electric current and enables the broken wire to be handled in safety. The Traction Company people believe the invention a very valuable one in protecting life.

Washington, D. C.—Second Assistant Postmaster General Neilson is giving a deal of attention to special mail service in large cities. He has ordered prepared maps of all large cities showing the surface car lines with a view of having mail cars run over them. He expects to give his attention especially to carrying mail on electric cars which run from centre of cities to the suburbs and to adjoining smaller towns. Cable roads may be utilized where possible, but Mr. Neilson is of the opinion that only on electric lines running long distances will it be profitable to carry the mails.

New York.—At a recent meeting of the Board of Electrical Control a new device for evading the law as to overhead wires was reported by the secretary. It appears that during the last few weeks wires have been strung across Broadway and some other down town streets without the permission of the board, and it was only with difficulty that they were discovered. The offenders had secured fine wires, in some cases covered with green silk, so that they were almost invisible against the sky. Six specimens were shown to the board. Although the owners of the wires could not be found in all cases, some of the wires were traced to offices. Commissioner Storm was empowered to consult the district attorney as to the means of punishing the offenders.

COMMERCIAL PARAGRAPHS.

The Mather Electric Company of Manchester, Conn., report the following recent sales in their Isolated Lighting Department: North Packing and Provision Company, Somerville, Mass., 1000 light dynamo (third order). Hermann, Aukan & Company, Lebanon, Pa., 600 light dynamo. Church Green Electric Light and Power Company, Boston, 600 light dynamo (ninth order). Iowa School for the Deaf, Council Bluffs, Iowa, 600 light dynamo. Connecticut River Paper Company, Holyoke, Mass., 700 light dynamo and two 15 H. P. Manchester motors. Henry R. Worthington, Hydraulic Works, Brooklyn, one 300 light dynamo, one 10 H. P. motor and one 45 H. P. 220 volt generator. J. B. Williams Company, Glastonbury, Conn., 150 light dynamo. Graff Bros., Lake Crystal, Minn., 150 light dynamo. Ohio State University, Columbus, Ohio, 15 H. P. Manchester motor. Grenada Hotel, Chicago, Ill., 450 light dynamo. Barney & Smith Manufacturing Company, Dayton, Ohio, 3 H. P. Manchester motor. B. T. Sturtevant & Company, Chicago, Ill., 10 H. P. Manchester motor. G. M. Angier & Company, Boston, Mass., 100 light dynamo. Candee Company, New Haven, Conn. 50 light dynamo. Moorehouse Bros., Chanterico, 50 light dynamo. Odd Fellows Hall, Philadelphia, Pa., one 30 K. W., one 50 K. W. and one 80 K. W. dynamos, direct connected, and 50 H. P. in motors. S. N. Blake, Elmira, N. Y., 350 light dynamo. Nardi, Strang Company, Philadelphia, Pa., 50 light dynamo. George W. Furbeck, Chicago, Ill., 250 light dynamo. C. B. Boothe, Los Angeles, Cal., two 5 H. P. and one 3 H. P. Manchester motors. Balger Lumber Company, Kansas City, Mo., 100 light dynamo. Leafe Bros., Winchester, Va., 50 light dynamo. Stanley Laboratory Company, Pittsfield, Mass., 10 K. W. Exciter. Diamond Machine Company, Providence, R. I., 300 light dynamo. West Virginia Improvement Company, Pocahontas, West Va., 30 K. W. 220 volt generator.

Eugene Munsell & Co., 218 Water street, New York, have for delivery on application their Standard Price List of Electrical Mica. The book is handsomely printed, in two colors, and besides the price per lb. and size of sheet of their manufactured Mica, gives an alphabetical Code for the use of near or distant purchasers who prefer this method of ordering or referring to the various sizes. A number of cuts are given of stamped solid sheet mica segments for street car motors and rheostat mica, which articles the company's presses and dies are prepared to stamp from the solid sheet in the exact pattern required.

The Metropolitan Electric Company have just arranged to take the product of a well-known Glass Factory for Insulators, and they will be able to furnish the market with standard grades of Insulators at factory prices. A large stock will always be kept on hand and immediate shipments can be made. The Metropolitan Electric Company can be congratulated on this important connection, as it places them in closer touch with their customers upon staple lines of goods.

INCORPORATIONS.

The Chillicothe Electric Railroad, Light and Power Company, Chillicothe, Ohio—to build or acquire and operate electric, horse or other motive power street railroad, furnish electric light and power, etc. Capital stock, $100,000. Promoters: Jos. P. Myers, Jno. A. Poland, Willard A. Story, Richard Enderlin, Jos. M. Klingelsmith.

The Mount Carroll Electric Light Company, Mount Carroll, Ill. Capital stock, $12,000. Incorporators: Owen P. Miles, Oscar F. McKinney and William O. Sayers.

The California Gas Engine Company, San Francisco, Cal.—to manufacture, operate and deal in vapor gas, electrical engines and machinery, etc. Capital stock, $100,000. Promoters: P. M. Hendry, J. G. McElvaney, Chester Varney, all of San Francisco.

The Independent Illuminating Company, Chicago, Ill.—to manufacture and sell gas, electricity, compressed air and other articles or compounds for the purpose of supplying light, heat and power. Capital stock, $10,000. Promoters: Christopher Treiber, John McMillin, Geo. Ham.

The American Electric Smelting Company, Wheeling, W. Va.—to manufacture aluminum and other metals by electric or other processes for the production of articles of like nature, etc. Capital stock, $1,000,000. Promoters: Jno. A. Campbell, Chas. Menkemeller, Thos. H. B. Haase, Wheeling.

The Pacific Electrical Company, San Francisco, Cal.—to deal in and manufacture electrical and other goods and do a general manufacturing and construction business. Capital stock, $30,000. Promoters: W. S. Beckwith, Piedmont Springs; I. E. Richey, Oakland F. H. Kimball, Jno. T. Hogan, Geo. A. Clough, San Francisco.

The Dolgeville Telephone Company—to connect local points in and about the village of Dolgeville, Herkimer County, N. Y. and adjacent villages and towns. Capital stock, $5,000. Directors: Alfred Dolge, William S. Armstrong, Theodore Roth, of Dolgeville, and others.

A company has been incorporated for the purpose of building an electric railroad from the Connecticut State line above Port Chester, N. Y., and through that village to Rye and Mamaroneck. Several well-known men of Westchester County and vicinity, including Congressman William Ryan and William L. Ward, are among the incorporators.

The Electric Match and Advertising Company, Cincinnati, Ohio—to sell, hire and lease mechanical electrical devices used for advertising purposes and as a cigar lighter, etc. Capital stock, $10,000. Promoters; Talton Embry, Geo. Slimer, Jos. T. Homan, O. J. Wiggins, Wm. Montgomery.

The Prairie State Construction Company, Chicago, Ill.—to acquire and operate cotton compress, build railroads build and maintain electric plants, furnish light, power and heat; construct and operate street car lines using steam, electricity or animal power; maintain and operate telegraph and telephone lines. Capital stock, $500,000. Promoters: Hosea W. Wells, V. H. Surghnor, E. A. Maynard.

The Consumers' Electric Light Company, Pana, Ill.—to furnish electric light, power and heat. Capital stock, $5,000. Promoters: O. H. Paddock, D. J. Overholt, J. C. McQuigg, W. W. Morrison, J. J. Conner, Aug. Reher, Jno. Kuhn.

The Ash Automatic Electric Switch Company, Newark, N. J.—to manufacture and sell automatic electric traction switches and other railway apparatus. Capital stock, $300,000, with $1,000 paid up. Incorporators: Joseph Samuel, Moses Hirsch, Walter V. Ash and Joseph Hardy Ash, all of Newark.

The New Mexico Electro-Chemical Reduction Company, Chicago. Capital stock, $100,000, Incorporators: Otto R. Barnett, Glenn E. Plumb, Clark Edward Ridpath. The Mexican Electro-Chemical Reduction Company, Chicago. Capital stock, $100,000; same incorporators.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED OCTOBER 2, 1894.

ELECTRIC RAILROADS AND APPLIANCES.

526,704. Trolley-Wire Hanger. John J. Green, Boonton, N. J., assignor to the Loando Hard Rubber Company, same place. Filed June 4, 1894.

526,705. Trolley-Spring. Julius L. Hanson, U. S. Army. Filed May 14, 1892.

526,756. Trolley-Guard. Henry J. Tanner, Lynn, assignor of one-half to Harry Fairfield Hamilton, Boston, Mass. Filed April 2, 1894.

526,767. Electric-Railway Conduit. Robert R. Wilson, Cincinnati, Ohio, assignor of one-half to Jeremiah M. Wilson, Washington, D. C. Filed Jan. 2, 1894.

526,832. Trolley-Cycle. Henry L. Gardner, Springfield, Mass. Filed Jan. 18, 1894.

526,835. Conduit Railway-Trolley. Robert J. Hewett, St. Louis, Mo. Filed Feb. 9, 1894.

526,850. Conductor-Switch. George H. Benjamin, New York, N. Y., assignor to the firm of Siemens & Halske, Berlin, Germany. Filed Sept. 28, 1893.

526,897. Electric Railway Trolley. Robert A. Grant, Providence, R. I., assignor of three-fourths to August F. Borchardt, Clifton A. Hall and John Conrad Schott, same place. Filed Jan. 22, 1894.

526,963. Conduit for Electric Railways. Michelangelo Cattori, Rome, Italy. Filed April 3, 1894.

526,985. Automatic Switch for Electric Railways. Wilber S. Wright and John E. Venus, New Orleans, La. Filed Dec 6, 1893.

ELECTRIC LIGHTS AND APPLIANCES.

526,825. Electric Lamp Hanger. William S. Weston, Chicago, Ill. Filed Jan 13, 1894.

MOTORS, DYNAMOS, ETC.

526,686. Electric Motor. John H. Clark, Boston, Mass., assignor to the General Electric Company of New York. Filed April 16, 1894.

526,742. Commutator. Henry G. Reist, Schenectady, N. Y., assignor to the General Electric Company of New York. Filed June 28, 1894.

526,743. Dynamo-Electric Machine. Edwin W. Rice, Jr., Swampscott, assignor to the General Electric Company, Boston, Mass. Filed Feb. 28, 1894.

526,810. Apparatus for Putting Electric Motors Into Circuit. Carl Hoffmann, Charlottenburg, assignor to Siemens & Halske, Berlin, Germany. Filed October 29, 1892.

526,879. Dynamo Regulator. John Van Vleck, New York, N. Y. Filed May 31, 1894.

527,023. Differentially Geared Electric Motor. Benjamin C. Pole, Deanewood, D. C. Filed Nov. 12, 1892.

TELEPHONE AND TELEGRAPH APPARATUS.

526,888. Transmitter for Telephones. Mark O. Anthony, Cincinnati, Ohio. Filed July 28, 1894.

526,893. Fire-Alarm Telegraph System. William E. Decrow, Boston, Mass., assignor to The Gamewell Fire-Alarm Telegraph Company, New York, N. Y. Filed March 13, 1893.

526,965. Combined Telegraph Key and Sounder. Philip D. Cox, Jasper, Fla. Filed Jan. 9, 1894.

MISCELLANEOUS.

526,720. Electric Winding and Setting Clock. Henry Loriot, New York, N. Y., assignor to Henri F. Mouquin, trustee, same place. Filed Oct. 3, 1893.

526,721. Composition of Matter for Electric Conductors. Duncan Macfarlan, Philadelphia, Pa. Filed May 16, 1894.

526,722. Composition of Matter for Electric Conductors. Duncan Macfarlan, Philadelphia, Pa. Filed May 19, 1894.

526,733. Electric Igniting Apparatus for Fire-Engines. William C. Matthias and Wilmer Hartman, Reading, Pa. Filed Oct. 2, 1893.

526,725. Electric Snap-Switch. Amandus Metzger, Schenectady, N. Y., assignor to the General Electric Company of New York. Filed May 11, 1894.

526,736. Lightning-Arrester. Fred S. Pearson, Boston, Mass. Filed Sept. 7, 1891.

526,760. Electric-Alarm Operating Mechanism. Parker C. Thompson, Elmira, N. Y. Filed Dec. 19, 1893.

526,813. Electrical Switch Setting, Indicating, and Controlling Device. Karl Moderegger, Vienna, Austria-Hungary, assignor to Siemens & Halske, Berlin, Germany. Filed Nov. 15, 1893.

526,833. Electric Belt. John J. Haukey, Beaver Dam, Wis. Filed July 18, 1894.

526,867. Rheostat. Duncan Macfarlan, Philadelphia, Pa. Filed May 18, 1894.

526,909. Electric Lock. Theodore P. Fratt, Boston, assignor to James Wilkinson, Everett, Mass. Filed May 7, 1894.

526,966. Electric Friction Brake. Bergen Davis, Newark, N. J. Filed March 28, 1894.

526,982. Magneto Call Bell. Joseph B. Smith, Manchester, N. H. Filed April 27, 1894.

526,988. Electric Switch. Frank G. Beron, Waterbury, Conn., assignor of one-half to James F. Gaffney, same place. Filed June 21, 1894.

527,034. Scale and Index for Electrical Measuring-Instruments. Edward Weston, Newark, N. J. Filed March 15, 1894.

527,037. Electric Mouth-Battery. Levi L. Funk, Chicago, Ill. Filed Nov. 27, 1893.

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EDITORIAL NOTES.

Shall We Pump Coal or Transmit Current? Will it be more economical to pump coal through pipe lines from the great coal fields to our cities, or to transmit the current, as proposed, from Niagara, or directly from large generating stations at the mines? Will any of the foregoing methods supplant the present system of local generating stations for light and power?

Thinkers and scientists have already given much thought to the great waterfall and the coal mine as centers from which current might be delivered hundreds of miles away, driving out, by their greater economy, the local steam plants. The leading exponents, however, of long-distance electrical transmission, the most optimistic of them all, recognize that there is and must be a limitation to the distance over which transmission is economical and therefore practical. None would claim, at present, that the practical distance is over 200 miles.

As is well known, ELECTRICITY'S views on this subject have been radical; they have even been called pessimistic. The next twelve months should determine whether we are correct in setting the limit of economical transmission at 30 miles, or the optimists in setting it at 200 miles.

The theoretical discussion of the Niagara scheme may be considered as ended. The enterprise is so near completion that we shall soon have actual results, which are always worth volumes of argument in settling disputes. And when these results are made known it will practically settle also the question of transmission from the coal fields. At least, if the Niagara scheme is successful, we shall know that an enterprise of a similar nature at the mines, substituting the culm bank for the waterfall as the basis of power, would also be successful.

Meantime there is another scheme before the public. the question of success or failure of which will be solved by actual practice almost as soon as the question of long-distance electrical transmission from Niagara. It is the pumping of coal through pipes over long distances. The methods by which it is proposed to do this are clearly explained in another column. It is not a visionary scheme. The inventor, or originator, is not a scientist, but one of the shrewdest business men in America, who has made a large fortune and is adding to it every day. He has made a careful study for many years of the problems connected with the mining and haulage of coal, and of the delivery of steam power as a commercial business. There is no higher authority in this country on the use of coal as a steam-producing agent.

This gentleman is Mr. Wallace C. Andrews, who first conceived and carried to success the plan of pumping oil direct to the seaboard—the plan which, more than any other feature, made the prolonged monopoly of the Standard Oil Company a possibility. Mr. Andrews is now the President of the New York Steam Company.

The idea of pumping coal through pipes is not new, it having first been made public by Mr. Andrews in 1891, though he outlined it to his employés ten years earlier. There was also an exhibit of the system in an obscure corner of the Mining Building at the World's Fair last year.

A company has now been formed, for which $2,000,000 capital has already been raised, to put the plan into practical operation on a large scale, pumping coal from mines owned by the company, and within the next six months the results will be made known.

It will at once suggest itself that if the scheme is practical as outlined in the article on the subject which we print this week, it would be equally so, and more economical, to make use of the almost inexhaustible culm banks of Pennsylvania rather than to mine lump coal.

A few weeks ago, in conversation with one of the pioneers of electrical development, Mr. Edward H. Johnson, we were struck with his optimistic views as to the possibilities for the continuation of this development. He suggested that it was entirely within the probabilities that the present generation would witness the abolition of coal burning on Manhattan Island, and that stringent laws would be passed in that line; that a gigantic generating station on the Jersey shore would supply all the power used here, displacing the thousands of isolated steam engines.

Who will say that with the knowledge acquired in the Niagara scheme as to the best plans for transmission and distribution of the current, and with coal pumped direct to the seaboard in pipes at a fraction of the cost for freight and haulage, this dream shall not be realized in the next decade?

* * *

Electric vs. Steam Railways. The growth of interurban electric railway lines has been so rapid in New England within the past two or three years that it has made serious inroads on the local traffic of the steam railroads in that section. This condition is being noticeably felt by the New York, New Haven & Hartford and the New York & New England railroads, whose local travel has been considerably reduced at several points by electric roads which parallel their tracks. The officials of these roads evidently appreciate the danger from such competition, as recently a complaint was filed in the Superior Court at Hartford, Conn., by the New York & New England Railroad, against the Bristol & Plainville Electric Railway Company, for paralleling its track in violation of the law.

The complaint also cites that an electric railway cannot be built under the law between two towns unless a public need for such road is first shown. The decision in this case has not yet been handed down, but is awaited with considerable interest by the steam railroad companies to whom an adverse decision means a decided loss of income.

Another point in this connection is the question of mail service, which is receiving considerable attention at the hands of the Post Office Department. Assistant Postmaster-General Neilson has been investigating the subject of special mail service with reference to long electric lines, and has expressed the opinion that such roads can be profitably utilized for carrying the mails between local points. This business has always been considered the prerogative of steam railroads, yet a number of trolley roads are already engaged in carrying mails, and, in some cases, special electric mail cars have been used in which the work of distributing and cancelling is carried on in the same way as in the cars on steam roads.

Another direction in which electric car lines threaten to cut into the income of steam roads which they parallel is in carrying freight and doing a regular express business along their lines. This has been undertaken by quite a number of roads and has already met with considerable success. Some of the companies have gone into the business extensively enough to require special cars for this service and such cars will probably be required in most cases where freight and merchandise of all kinds are handled. Wherever this has been tried it has been well patronized, especially on suburban lines and outlying places which have been built up by the trolley roads. The delivery of bundles and freight in such districts tends to popularize the trolley with suburban patrons and draws correspondingly from the traffic of the steam roads. Such an express or freight service is also in general far more convenient than that of the steam car.

It is very obvious that in some respects electric railways have advantages which make them preferable to steam roads with the public for local travel. The chief of these is perhaps the fact of their taking on and letting off passengers at any point on the route instead of confining them to the use of two terminal stations as in the case of steam lines. From the experience already gained by the steam railroad companies in the loss of local traffic, it is apparent that electric roads are sure to ultimately provide for this travel where it is reasonably heavy, and the question confronts them now whether to provide electric traction for this purpose or to allow their income from this source to be diverted into the pockets of other companies.

* * *

Electric Disinfecting Plants. We give elsewhere a brief description of the electric disinfecting plant at Riker's Island, which was visited and inspected last Thursday by the members of the New York Electrical Society. The importance of this process, which appears to be practically identical with that of M. Hermite, cannot be more thoroughly demonstrated than in the case of Riker's Island, which was in about the worst condition that any disinfecting process could desire for a test of its efficiency. Before this disinfecting was undertaken, the odors from this place had become intolerable, as every passenger on the Sound boats can testify, while at present the island, although not as sweet as could be desired, is greatly improved in odor and is not particularly offensive.

In view of the great improvement which this process has effected there, no better proof of its value need be required. Several of these plants have been in operation abroad with equally satisfactory results, and as the process can be beneficially applied in numerous places and is by no means expensive, it appears to open a new field for electrical enterprise.

* * *

Telephone Rates and Politics. The Members of Assembly in this State who voted last winter against a compulsory reduction of telephone rates, and who are seeking re-election, are meeting with opposition from an unexpected quarter.

At a recent meeting of the Kings County Pharmaceutical Society the following was passed without a dissenting vote:

> *Resolved*, That the trustees recommend to this society and to the druggists of Brooklyn that they do not vote for or support the following named Assemblymen, should they be nominated, for the reason that they opposed the bill reducing telephone charges.

There are several thousand doctors and druggists in Brooklyn and they can no doubt beat the men they are after.

However, Brooklyn is in a fair way to have telephone competition very soon, and rates will come tumbling down without the compulsory legislation asked for, which is never a good thing.

* * *

If the Pennsylvania Railroad Company expect to have smooth sailing in their future dealings with electrical men, they must first refund the excess baggage charges for which the N. E. L. A. was mulcted at the time of the St. Louis Convention.

False Economy. We have noticed in several of our contemporaries of late a great deal of advice to railway companies, all in the same strain, to wit, that *now* is the time to make purchases of apparatus, even of equipment which will not be needed for a year, because prices are at bed-rock and will soon be higher instead of lower.

This advice sounds well and is no doubt based on a correct theory. But it is not safe to make large commercial transactions on theory alone. Frozen facts make a better foundation.

Sufficient has been said in this line, however, to call the attention of all interested parties to the whole question of prices of electric railway equipment.

The continual lowering of prices for the past five years is a matter of record. The results obtained from the various makes of apparatus is also a matter of record. Is it a fact that the cheapest apparatus has proved economical in use? We think not. The item of repairs and breakdowns, entailing perhaps the stoppage of an entire system, is of greater moment, in determining what apparatus is the most economical, than the question of first cost.

Since the price of car equipments fell below $1,100 the General Electric Company has been forced to make further reductions, until sales have been made by them as low as $625 for complete car outfits with two 25 H.P. motors. Why they have done this is, to outsiders, not easy to understand.

We take it that the financiering element in the management, caring less about genuine commercial success than about prolonging their opportunity for stock speculation, have compelled the selling department to sell goods regardless of price, thereby creating the appearance of successful business.

One of the keenest students of the electrical situation remarked a few days ago that one of two things is certain: either the General Electric Company is losing money on every car equipment sold, or else they are turning out inferior product, which no railway company can afford to buy at any price, however low. And this, we believe, expresses the situation in a nutshell.

There is still enough commercial sense left in the neighborhood of the Broad Street office to make it difficult to believe that the G. E. Company is selling railway apparatus at an actual loss.

There always have been, and perhaps always will be, a large number of railway companies in the field controlled by speculators who have no more interest in the legitimate commercial success of their enterprises than have the directors of the G. E. Company. They want to make a showing on paper, to float their bonds, unload their stock and get out, leaving to others the actual operation of their systems.

We suppose that this class of purchasers—the speculative fly-by-night concerns—will continue to avail themselves of the extreme low prices offered by the General Electric Company, and will not go above this company's standard price of

$600 to $650 per car equipment. But companies who are in the business to stay, and who intend to build up solid commercial successes, will buy the best apparatus to be found in the market, even if it costs double the prices mentioned.

The old rule that the best is the cheapest applies to nothing with such absolute verity as to mechanical products.

* * *

Southern Courtesy. A large manufacturing company recently had occasion to begin a patent suit in an interior county of one of the South Atlantic States. The regular legal form of notice was sent to the County Clerk, the printed introduction of which contained the information that a temporary and permanent injunction was prayed for; then follows the request on the County Clerk to issue the necessary subpœnas to defendants. The County Clerk replied, with true Southern courtesy, that he could not see his way clear to issue the injunction, although he would like to do so, but of course he would attend to the subpœnas.

* * *

Some time ago the General Manager of the Railway Department of the G. E. Company issued a confidential circular letter to the agents explaining the alleged defects in the construction of direct-coupled generators manufactured by a large firm of world-wide reputation. This letter, of course, distorted facts in order to give the G. E. agents talking points, and the letter, we understand, was promptly answered by the other company explaining matters satisfactorily to prospective purchasers of apparatus. One of the agents of the Chicago office, well known for his libertine ideas, and for that reason well adapted to follow out the disreputable methods of the G. E. Company, went to a general contractor, leaving a copy of the circular letter, but omitting the head-line and signature, with the statement that this letter contained the unbiased opinion of an electrical expert who had investigated the General Electric Company's competitor's direct-coupled machinery. There are legitimate and illegitimate methods employed in selling, and we must class deliberate lying as a disreputable method. But what can be expected of salesmen in a company headed by a confidence man and managed from the first like a bunco game?

* * *

Mr. W. W. Gibbs, of the Chloride Accumulator Company, has something interesting to say in this issue in regard to the widely advertised injunction recently secured by the Accumulator Company. The chief fact of interest to the trade in all this controversy is that Mr. Gibbs's Company has given us a storage battery which is a commercial success—the first one in America to be sold under guarantees which make it a safe investment. They are able, moreover, to fight their battles in a way to furnish the public with both entertainment and instruction.

* * *

We understand that many of the Atlanta visitors will make a pilgrimage to Dahlonega to pay their respects to the Hon. Dink Botts.

A local Detroit paper states that there is an intense feeling of gloom pervading the offices of the Public Lighting Commission in Detroit. Mr. Alex. Dow, the engineer of the commission, is reported as saying: "It is realized that we are to be left by the mayor at the mercy of all the interested and corrupt forces that are at work against the Commission's contracts and against the public lighting policy." We cannot report the situation in Detroit, because there is no situation there. It looks, however, as though the McDonald interests would win the long fight.

We wonder if Engineer Dow is not ready now to admit that Electricity was right in stating that he had made the mistake of his life in accepting the appointment from the Commission? His salary has not been large and we are certain he has been kept very busy.

* * *

The city of Toronto has apparently abandoned the municipal plant idea, it having been shown that the Toronto Electric Light Company's proposition was lower than the city could hope to equal with a plant of its own. The only place for a municipal plant is in a town which cannot support a commercial company. Then the corporation is justified in giving the citizens the benefits of the electric light—and making them pay for the luxury in increased taxes.

* * *

We salute our esteemed contemporary, the *Pacific Lumberman, Contractor and Electrician*, on the independence shown in its comments on Dr. Addison and the General Electric Company's methods in the West. There is nothing wrong with electrical transmission, and if our California friends will only patronize the proper companies they will have no trouble with their plants. A second-class dentist, however, should not pose as a first-class engineer.

The Battle of the Quacks.

Does Electric Treatment Enhance or Destroy Beauty?

WHERE TO APPLY IT.

(From the Chicago Record.)

Electricity is greater than any cosmetic as a beautifier. It also puts more and firmer flesh on the face in a shorter space of time than any known tonic. Its effect is healthier than any oil, cold cream or manufacturers' evils that are in continual use by slender women desirous of the abolishing of prominent bones and wrinkles. The amount of current to be turned on can be learned from any physician, and there are not sufficient volts to cause death. . . . It should be applied at the two extremes of the day.

BARBAROUS CRUELTY, SAYS THE VENDER OF COSMETICS.

(Mme. Yale in the Chicago Despatch.)

The electrical treatment is a cruel one. The tender face is scorched and burned and to save a little of the pain the deadly drug cocaine is used. The art of beautifying should be made a universal study, and it should be adopted as one adopts the study of any other physical, social or moral law. The electrical and poisonous treatments are those of wanton cruelty and should be avoided, and I, who have had nineteen years' live experience in this great work, advise you to shun them as you would shun food that is poisoned.

Mme. Yale is a beautiful woman despite her —— years, and she advocates cosmetics.

Prof. Rowland, the leading physicist of this country, Prof. Houston, President of the American Institute of Electrical Engineers, and Nikola Tesla are three of the ugliest men one could find in a day's search.

Therefore the burden of proof is in favor of cosmetics over electricity as a beautifier.

Street Railway and Illuminating Properties.

The first annual statement of the above company shows:

Securities received from the G. E. Co	$12,188.267
" " " other Co's	683,518
Par values of securities disposed of during the year	2,472.229
Securities now held at par	10,399,556
Cash balance	5,191
Income acct. balance	13,627

There have been retired during the year 13,561 shares preferred stock at an average cost of $92.19, showing that the syndicate has realized from the securities sold (par $2,474,229) $1,269,006. On this basis the syndicate would realize a profit of $2,418,000 in round numbers on their investment. Thus their original commission of $450,000, or a net profit of $2,868,000 on an investment of $4,050,000.

These figures, however, are presumably too small, as the poorer securities have, to our knowledge, been disposed of first. There are several dividend payers among the remainder. We are convinced that the final balance sheet will show a much larger rate of profit.

Our English Friends are Strong on Celebrations.

Nearly every part of London and its suburbs is supplied publicly with the electric light. The latest installation inaugurated is at Hampstead, where about £30,000 has just been expended upon plant, buildings and machinery. On Monday night, October 1st, a commencement of the supply (both public and private) was made, the event being celebrated by the usual festivities. The Vestry have the work in their own hands.

The Old, Old Story.

Trolley vs. Horses.

During the last quarter of 1894 the Newburg (N. Y.) Electric Railway was operated by electric power, but during the same time in 1893 horses were used. A comparison of the results shows a wonderful change. During the 1894 quarter the gross earnings from operation were $20,222, against $6,301 during the 1893 quarter. Operating expenses were $9,082 against $5,377, making the net earnings from operation $11,139 against $924. The gross income was $12,278 as compared with $1,005 last year. The net income for the 1894 quarter was $7,756. During the 1893 quarter the cost of operation was 82.11 per cent. of the gross earnings. In the 1894 quarter electricity had cut down the percentage to 44.85 or to 45.75 including taxes.

Cleveland Electric Club.

At the annual meeting of the Cleveland Electrical Club, President C. W. Wason delivered a retrospective address, in which he congratulated the club on its success, both from an educational and financial point of view. Treasurer O'Neil's report corroborated Mr. Wason's remarks. The election of officers resulted as follows: President, C. W. Wason; first vice-president, B. M. Barr; second vice-president, T. E. Adams; secretary, H. D. Davis; treasurer, E. W. Moore; board of managers, R. M. Fuller and George W. Cleveland. President Wason will give a complimentary dinner on October 24.

Adopt American Habits and Take It Straight.

(From Lightning, London.)

I have received this week a somewhat amusing letter from a correspondent who wishes to apply an electric current to the purification of well water from iron contamination. His chief objection to the use of this water is that it turns whiskey black. It seems to me that he has by no means proved that the water is at fault, and, although I am not a chemist, I would suggest to him to look to his whiskey as well as his water. Blackening by iron salts is usually due to sulphuretted hydrogen or tannin, and it must be a poor sort of whiskey that contains either of these ingredients.

Sad Affliction to the Family of Mr. Thomas B. Kerr.

One of the saddest accidents caused by the recent gale along the coast occurred in Englewood, N. J., in the home of Thomas B. Kerr, on the night of Monday, the 8th inst. At about 5 o'clock, when the wind was most furious, a chimney was blown over on the roof of his home on Chestnut street. The mass of brick crashed through the roof and fell upon his 22-year old daughter, Miss Mary M. Kerr, as she lay asleep. She died of her injuries two hours later.

Mr. Kerr was not at home, having been detained in New York over night on business. In his house were only Mrs. Kerr, her daughter Mary, her 15-year-old son Clarence, and two maid servants.

Miss Kerr had been busy preparing for a party which was to have been given on the 10th in honor of her brother's twenty-first birthday. The invitations had been issued and all the young society people of Englewood, as well as many in New York, were anticipating a pleasant time.

Mr. Kerr is a member of the law firm of Kerr & Curtis, 120 Broadway.

The Gigantic Wheel in London.

For some time past there has been in course of erection at the Earl's Court Exhibition, London, an immense wheel after the style of the Ferris Wheel recently exhibited at the World's Fair. It was intended to make this an additional attraction at this year's exhibition, but as the work could not be completed in time the exhibition has been prematurely closed. The diameter of the wheel is to be 300 feet. The horizontal axle alone will weigh 53 tons and the plummer blocks 11 tons each. The erection of the wheel spokes and rim will be dealt with in four sections, each weighing 150 tons. There will be forty carriages, each capable of carrying forty passengers, but up to the present only one of these has been delivered. Two 50 H.P. steam engines (Robey) will rotate the wheel. Each carriage will be lighted by electricity and there will be a double line of electric lamps all round the rim of the wheel. A separate engine will drive the dynamos.

New York Electrical Society.

On Thursday afternoon, October 11, about one hundred members of the New York Electrical Society paid a visit of inspection to the new permanent electro-disinfecting plant on Riker's Island. The boat conveying the party left the pier at the foot of East 33d street and was met at the island by Commissioner Andrews, who conducted the party over the plant and made an address explaining the system. The method is a modification of the Hermite process and consists in merely electrolyzing sea water. The building contains six large wooden tanks, into which the sea water is pumped at one side and from which it is discharged at the opposite side after passing the large electrodes situated just over the discharge pipe.

The tanks are arranged in three series of two each, and each pair is supplied with a current of 750 amperes at 14 volts by three Hockhausen dynamos. The capacity of the plant is 1,200 gallons of electrolzyed water per hour.

The action of the disinfectant is said to be due to the formation of hypochlorite of the salts in solution, and its effect on Riker's Island, which has been used as a dumping ground, have been a very great success.

The party returned to the city about 5 P. M. and were shown some experiments on the chemical effects of the disinfectant on the return trip.

BOOK REVIEW.

Professor Barrett's Book.

ELECTRICITY AT THE WORLD'S COLUMBIAN EXPOSITION. By PROF. JOHN B. BARRETT, 12mo, pp. 501. Chicago, 1894. Price $5.

We have already noticed briefly Prof. Barrett's book, for which we have never received any thanks, yet real merit is never injured by newspaper criticism.

A copy has been at hand for some weeks. We have not read it carefully, and we don't see how any one could unless he could find enjoyment in the constant perusal of trade catalogues.

The illustrations are good, some of them excellent, the most striking one being the full page frontispiece representing the Professor engaged in his literary work. There is a far away look in his eyes as though he were expecting some ideas to float in at the window. After a somewhat extended acquaintance with books and writers, we can say that this is the first instance we have noticed of a living author publishing a portrait of himself in a work of this nature. It is a fashion heretofore confined to cheap novelists. But, as the Professor is a man of good taste, it must be all right.

The book ought to have a large sale. Every concern whose exhibit is described ought to buy at least ten copies for advertising purposes. The matter furnished by each one has been printed almost verbatim, and is of course discriminating.

There is a good deal of matter which seems trivial to us--but we did not edit the book.

It is stated that the " Electric Light Scarf Pin (exhibited by Otto Rauda) consisted of a small incandescent lamp mounted on a scarf pin, with silk-covered conducting wires," etc. This fact should not be lost to history.

We are also told that in the lighting of one exhibit " there were twelve byzantine arc lampe, six nickel-plated arc lamps, eight regular arc lamps,... fourteen regular arc lamps, and two twin-carbon arc lamps,"—all novelties and worth mentioning, of course.

Schuckertt (sic) is only one of a score of words which are misspelled throughout, showing that Doctor Hornsby, who received a first-class common school education at Heidelberg College, Tiffin, Ohio, did not give enough attention to proofreading.

In the chapter devoted to the electrical press, there are mentioned only five journals. A page and a half is given to the *Western Electrician*, a half page to the *Electrical Review*, an eighth page to the *Electrical Engineer*, and none at all to the *Electrical World* or ELECTRICITY. This shows the relative value placed upon the free advertising offered by the Chief of the Electrical Department in his great book by the various journals. The first time the *Electrical World* and ELECTRICITY ever agreed on anything was in considering this value *nil* and declining to furnish copy for a free puff.

There is no mention of the electrical quacks who occupied a large share of the gallery space. Why were they not again assessed ?

Review of Industrial Literature.

The *Engineering Magazine* began a new department with the October number, being a monthly review of the leading articles in the "industrial press."

Properly edited by a man of wide knowledge and the necessary discrimination, this should be a valuable department.

Removal Notice.

Messrs. G. M. Angier & Co., New England contractors for the Mather Electric Company, have removed their offices from 116 Bedford street, to 64 Federal street, Boston, Mass., where they have secured a suit of offices far more suitable for their business than the old quarters.

GENERAL ELECTRIC'S METHODS.

Peculiar Situation of the Pennsylvania G. E. Company.

[STAFF CORRESPONDENCE OF ELECTRICITY.]

We received some time ago a request for a report on the affairs of the Pennsylvania General Electric Company and on some of the local lighting companies in the neighborhood of Philadelphia. As our knowledge of these companies was limited, and of the most general character, we withheld our opinion until we could make a careful investigation.

From the Second Annual Report of the G. E. Company, in the list of stocks owned in manufacturing and other companies we found that the G. E. Company owned stock in the Pennsylvania General Electric Company to the amount of $468,000 par value. There was nothing in the report, however, to show at what valuation this amount of stock was carried upon the books of the company. We knew that the Pennsylvania General Electric Company was capitalized at $500,000, and that this stock had been acquired by the G. E. Company from the T.-H. (Boston) Company at the time of the consolidation. This showed us that the G. E. Company held 4,680 shares of stock out of a total of 5,000 shares. For a moment a feeling of pity came over us for the unfortunate minority holders of the 320 shares of stock. We asked ourselves, How does it happen that the G. E. Company do not own these 320 shares? We knew that the Lynn shoemakers were not in the habit of giving anything away, or of overlooking anything that was not nailed down. We think our feelings must have been somewhat similar to those of some great inventor who stands on the very verge of making a great and important discovery. We made careful mental notes and then continued our investigations, resolving to return to this point at our leisure. We next made a most careful and thorough search of the records of the New York, Boston and Philadelphia stock exchanges without being able to find any record of any dealings in this stock.

We resolved, however, not to let the matter drop, but to return to the points of discovery and do further prospecting. These 320 shares of stock kept continually coming into our mind, and the subject seemed so very inviting and promised such interesting results that we resolved to lose no time in resuming our search. We believed that we had struck a lead that would develop a most interesting state of affairs, and even at this early stage we could plainly see the finger of Charles of The Golden Rule most conspicously in the pie, and the most unmistakable evidences of T.-H. Boston financial genius and business finesse. These last few words do not exactly convey our thoughts at the time, but we will defer drawing on our reserve fund of good old Anglo-Saxon until later on. It is more expressive, if not always quite so polite. We had good reasons for believing that in the City of Brotherly Love we should find the holder of the 320 shares of stock in the person of some confiding, long-suffering and unsophisticated Quaker. How far we were correct in our surmises our readers will see if they will follow us through to the end of our journey.

Arrived at Philadelphia, we proceeded to consult the City Directory. We found that the offices of the company were located at 509 and 511 Arch street. It afterwards turned out that we were very fortunate in having correctly copied the address, as we otherwise would have been unable to locate the offices, for there were no signs or any other indications upon either of the buildings to show that they were occupied by the Pennsylvania General Electric Company. The building at 511 is a very ordinary looking two-story affair with a mansard roof. Upon this roof, and facing the street, is a weatherbeaten sign bearing the unintelligible name of some former occupant. We were able to decipher sufficient to show that the concern had been engaged in the theatrical lithographic printing business The building at 509 is even less pretentious in appearance than its neighbor, but while it is only a single story front, it is in a certain sense the more striking of the two. This is probably due to the fact that it is painted a deep black and has every appearance of being an undertaker's establishment. It was formerly used for an insurance patrol station, but was abandoned some years ago on account of its being entirely inadequate for the purpose. The firemen and horses are now located across the street in what might be well called luxurious quarters in comparison with their former home. Like its adjoining neighbor, no signs were visible except the old sign of the Thomson-Houston Electric Light Company upon the front window. We have received numerous explanations why these buildings have never been properly provided with signs. Among others we have heard that the old T.-H. sign was "just left on for luck." It has occurred to us that a possible solution might be found in the fact that the consolidation only took place two and one half years ago and that even the Schuylkill River does not *run* through Philadelphia. We believe that the company's branch offices at Pittsburg and Baltimore are properly provided with signs, according to usual business custom, for the benefit of the intelligent business public. The basements of both buildings and the greater portion of the ground floors are used for storing supplies and machinery. The rear portions of the ground floors are used for a repair and machine shop, and the storage of second-hand dynamos and railway motors, acquired, we presume, by the well-known exchange (?) process. We noticed a number of T.-H. arc dynamos in various stages of debility waiting their turn to be put through the "rejuvenating process" in the adjoining machine shop. The process is really a very simple one, but to the uninitiated the results attained are most astonishing. The best proof of its success is the fact that a *second-hand* T-H. arc dynamo has never yet been sold by this company. Machines in use five years are repainted, brushed up and sold as new to confiding countrymen. To our inexperienced eye the greater part of the machinery in sight, and what was partly visible through the broken boxes, was of but little more than scrap value. We were beginning to think that in some respects the Quakers might not be so very slow after all. We then proceeded to the offices on the second floor, endeavoring to recall, as we mounted the stairs, a quotation that would express what was passing through our mind. But we couldn't.

Reaching the offices upon the second floor we inquired for the general manager. He was said to be in New York. Neglecting to inquire for the family relations, we then inquired for the secretary. We were informed that the secretary had resigned some months ago. Our next inquiry was for the treasurer. We were unable to learn that there ever had been such an officer. In despair we inquired for several old Edison men, old acquaintances of ours, whom we had long known as formerly connected with the Edison General Electric Company's interests in Pennsylvania. We were informed that none of them were any longer connected with the company. We thought of the old T.-H. sign, previously noted, and smiled. The sign was perhaps all right after all. We were informed that if we would wait, one of the department managers would be in shortly and would see us. A chair was finally given us, and we seated ourselves in a sort of hallway into which the different offices opened. While waiting we took occasion to look around us. We will always be ready and willing to refute any charges of extravagance or waste of money having been made in furnishing these offices. We do not wonder that the firemen and horses moved away.

Our next letter will contain a complete report on the Pennsylvania General Electric Company and information which will be anything but general in its character.

Philadelphia, Oct. 12.

RIGHTS OF ELECTRIC COMPANIES.

Underground and Overhead Wiring.

BY R. D. FISHER.

The subject of electric wires is receiving careful consideration at the hands of legislative, municipal and judicial powers. Highways in their primitive state were opened and dedicated for communication as well as travel, and in 1843, when the electric telegraph was assured, it naturally sought the public highways. There was little danger and no damage to private interests, and for many years little or no litigation grew out of it. But within a few years past the uses of electricity have marvelously multiplied; for all these uses the current must be distributed from a central generative source and carried by wires throughout the various ramifications of a system.

Legislative powers, however, readily recognize the useful and necessary presence of these conductors; that their subserved purposes are public and the conveniences emanating are enjoyed by all. The inventive genius of the age demonstrates that their use is far more likely to increase than to diminish. Their relations, therefore, to the public and private rights in the public streets and ways must be defined by legislation, conflicting rights must be adjusted by the courts, and the mode of suspending or laying wires must be determined and controlled by municipal authority.

The police power of a State must be exercised in a reasonable way. That power is derived from the Federal Congress. One of the State courts first confronted with this question was that of Pennsylvania, wherein it was held that a city has the right, if so empowered by its charter, to supervise and control, by proper and reasonable ordinance, the erection of poles upon and the stretching of wires along its streets and ways so long as such grant did not destroy or abridge the rights secured by the Federal statutes. But the multiplicity of wires has grown to a network of unsightly and conflicting interests, and acting on the line of the Pennsylvania Court the Federal Circuit Court of Southern New York has ruled that State legislation compelling the placing of wires under the surface of the streets in a city is not in conflict with the Federal act, nor an invasion of rights because such streets are letter-carrier routes or post roads.

Until quite recently statutory regulation of subways has proven partially futile because of the mistaken notion that subways would not be successful, and legislatures were inclined to limit municipal corporations to rules of experimental action. But the question is thoroughly settled that, through proper legislation, municipal corporations may be fully empowered to deal with the matter of subways for wires, subject to general regulations or restraints as experience may have shown to be either necessary or impossible. (See 2 Interstate Com. Rep., 533; 6 Railroad and Corp. L. J., 105, and 38 Fed. R., 555)

Almost the first legislation on this subject was that of New York, creating "a Board of Commissioners of Electric Subways," subsequently denominated The Board of Electrical Control in the City of New York. The act was held constitutional and the board was upheld in its refusal of permits for the continuance of electrical conductors above ground.

Other States now have similar statutes, and the former resistance to their observance has nearly ceased, the companies themselves growing more anxious to place their wires underground for their own benefit.

But under these statutes numerous actions at law were fostered and the decisions at our command are somewhat conflicting. It would seem to follow from weight of judicial authority tha *municipal corporations* have not the power to order existing overhead lines lawfully put up to be taken down and put underground, and there are few reported cases growing out of an attempt by mere municipal authority to compel an existing system to be placed underground.

To set out the general provisions of the American statutes on the subject of underground wires would require more space than we can claim hence, for purposes of review by interested parties we cheerfully add the following table of legislative acts concerning the erection of or removal of overhead wires and placing them in conduits or subways:

Connecticut—Laws 1887, Chap. 33, and Gen. Stat. 1887 Secs. 1477, 3946.
Nebraska—Gen. Laws 1887, p. 123.
Massachusetts—Acts, etc., 1880-81, Chap. 83, Sec. 1.
New Jersey—Supplemental Laws 1882, Chap. 172; Supp Revised, 1023.
New York—1879, Chap. 397; Amended, 483, Laws 1884 Chap. 534, 1884; 499, 1885, and Chap. 716, 1887.
Alabama—Code 1887, Sec. 3219.
Arkansas—See Digest, 1883.
Dakota—Sec. 3025.
Illinois—1883 Laws, p. 173; Rev. Stat., Sixth Ed., p. 1471-72.
Indiana—1888 Rev. Stat., Chap. 43., Secs. 4181, 4192.
Ohio—1890 Rev. Stat., Sec. 3454.
Louisiana—1876, Sec. 3760.
Minnesota—Rev. Stat. 1891, Sec. 2632.
Vermont—Rev. Laws 1888, p. 702.
Virginia—Code 1887, Sec. 1287.
Oregon—Gen. Laws 1872, Chap. 58.
U. S. Rev. Stat., Sec. 5253.

Pumping Coal Through Pipes.

A Striking Suggestion—The Plan as Outlined by the Inventor.

A company composed of some of the most conservative business men in this city has recently been organized to put into practical operation a pipe line for pumping coal from the mines to the seaboard.

The following details of the plan and the arguments in favor of it were presented to a representative of ELECTRICITY by the inventor, Mr. Wallace C. Andrews:

"I believe that I have invented a new and exceedingly valuable method of transporting coal from the mouth of the coal mine to the general market or place of consumption. I first grind the coal to a fine powder, and by the well-known process of 'washing coal' I remove an average of 15 to 20 per cent. of worthless matter. This consists of sulphurets of iron, dirt, rock and slate, which form the ash and clinker. Having thus purified the coal, I mix it one-half coal and one-half water, and pump it (precisely as crude oil is pumped) to market and deposit it in settling ponds or basins. These are cheaply made of earth embankment, with the ordinary plow and scraper. They will store 10,000 tons per acre.

"The quality of pipes is sufficient for the pressure, also size and quality of pumps; suitable grinding machinery is already in use; the washers for purifying the coal are in use in the four great countries of the world—the United States, England, France and Germany. To the plodding German mind, and to their necessities we are indebted for the highest perfection in coal washers, and also the recovery of the volatile and gaseous portions of bituminous coal in the process of coking, now in this country absolutely wasted.

"We have in this country an exceedingly wasteful and reckless method of mining and handling our coal. Many millions of tons are wasted annually, and it is said that there is probably gas enough going to waste at the open-top coke ovens in Pennsylvania and West Virginia to light every principal city and town in the United States. It is a part of my aim to save the waste, and to produce a better quality as well as to cheapen.

"One hundred and fifty million (150,000,000) tons of coal were mined in the United States in the year 1893, all of which was taken from the mines, and after, in most cases, repeated handlings, delivered in some form to the consumer. The cost of doing this by present methods is reckoned by hundreds of millions of dollars per annum. It is not done for $1 per ton ; one-half of it is not done ror $2 per ton; 50,000,000 tons of it is not done by present methods for $3 per ton.

"The cost of grinding will not exceed six cents per ton at or near the mouth of the mine. I also have proposals from Germany to establish here their latest machinery for washing coal, and guarantee it in plants of 500 tons per day at three cents per ton, and in plants of 1,000 tons per day at two cents per ton. This makes, say, ten cents per ton for grinding and washing at or near the mouth of the mine. They also guarantee that the coal thus purified will have but about three per cent. of ash and clinker, whereas coal as now shipped from the mines and delivered to the consumer by the present method of railroad and water carriage gives from 10 to 15 per cent. ash and clinker, and in many cases even more than this. The cost of grinding and purifying the coal is ten cents per ton, and the coal is worth at least fifty cents per ton more to the consumer.

' I have a report of tests made in Germany in the use of fine coal, showing an increase of 20 per cent. of evaporation; I have also a report of tests made in Pittsburg, showing 20 per cent. increase as compared with lump coal. I think my estimate of the increased value of the coal to the consumer, thus ground and purified, taking the country at large, and especially at points where coal is expensive, is a fair one at 50 cents per ton. When the dry powder of bituminous coal is blown into the fire-box the atoms explode and form the next best fuel to natural gas.

"The following table is made up from actual tests showing the coal-carrying capacity of pipes in tons per twenty-four hours : pumping stations 30 to 40 miles apart, according to grade (supposed to average from New York to Chicago 30 miles apart), with 1,200 lbs. pressure per square inch.

Size of Pipe.	Capacity per 24 hours.
4-inch will deliver	320 tons of coal.
6 " "	890 " "
8 " "	1,824 " "
10 " "	3,168 " "
12 " "	5,120 " "
16 " "	10,240 " "
18 " "	13,760 " "
20 " "	17,920 " "
24 " "	28,160 " "

"Where the world has been mistaken is that it supposed that this mixture would clog up the pipes. I find there is no tendency whatever to do this.

"We have found that we can not only pump a mixture of 50 per cent. coal and 50 per cent. water, but as high as 90 per cent. coal and ten per cent. water. The delusion has been that people supposed the coal to be so very much heavier than the water. The fact is that when pulverized to a fine powder, measure for measure, the coal is the lightest, because of the air it contains. When sent through the pipe line, however, and delivered into tanks or settling ponds and becoming quiescent, it settles very readily; 90 per cent. will settle the first hour, and the water is ready to be drawn off the next morning.

"The following is a synopsis of what I believe to be the facts as regards the saving in transportation:

"That coal can be carried by pipe line for one-tenth the cost of the carriage by railroad. I mean by this that the actual cost of carriage by pipe line per ton and the actual cost of carriage by rail per ton will be as one to ten.

"That the distribution of coal at the terminal points will show advantages equally great; that is, delivery into the settling ponds will be only 10 per cent. per ton of the usual and average cost of unloading coal; and that the delivery out of the settling ponds to the consumer, and to vessels, will be only 10 per cent. of the average cost by present methods."

The following is an extract from the award received for this system at the World's Fair :

"This exhibit is most remarkable, and we believe the method pregnant with certainties for the future transportation of coal from distant points through main pipes, as surely as for local use.

"Our judgment is that this method is destined, ere long, to become the carbon thoroughfare for the transportation of the motive power of the coming ages, and, for its great economic features, we recommend an award."

The Chemical Theory of Accumulators.[*]—II.

BY E. J. WADE.

Electrical energy does not exist as such in any galvanic cell, whether primary or secondary, but can only be absorbed or given out through the agency of corresponding chemical changes taking place in the cell itself, and its whole electrical behavior as regards E. M. F., resistance, capacity, and so on, could be predicted and explained were the nature of these changes exactly known. During the last twelve years a great deal of work has been done on lead storage cells in this direction and many valuable facts have been ascertained; yet at the present day very little is decisively settled as regards the precise chemical reactions that occur, and consequently many important characteristics, both good and otherwise, still remain to be satisfactorily accounted for. Probably many consider that time devoted to the elucidation of obscure chemical problems might be utilized to far greater advantage in attempting to construct better and more practical cells, and they are quite indifferent to questions of normal and basic sulphates, suboxides, peroxides, etc., but this is a mistake. It is true that in very few cases have the chemical theorists pointed the way to any improvements not already embodied in the best practice of the time, but rather have had to formulate their theories so as to account for electrical facts already ascertained; but probably it is for this very reason that storage cells are still so far from practical perfection, and have progressed so slowly as compared with dynamo-electric machinery and other apparatus in whose development theory and practice have gone hand in hand. A good deal has been said at one time and another about storage battery engineers and manufacturers not being chemists; but neither have the chemists who have gone into the subject been electrical engineers, and practical experience with storage cells on a large scale affords much information that could not possibly be obtained from laboratory experiments alone. In justice to the chemists, however, it must be remembered that the problems they have to face, even on their own grounds, are by no means easy. Dr. Frankland called attention to this in some remarks he made during the discussion on the paper by Prof. Ayrton and others on "The Chemistry of Secondary Cells," read before the Institution of Electrical Engineers in 1890.[†]

"The physical qualities of the cell are capable of very accurate estimation and investigation. But when you come to attempt to ascertain the chemical changes that occur in the charging and discharging of a storage cell you encounter formidable difficulties. Nothing seems more simple than to determine the chemical changes that take place in either the negative or the positive plate of a storage battery. It is not so in reality. The substance used as active materials are, in the first place, mixtures, and the materials obtained at the end of the reaction are also mixtures; and these mixtures are insoluble in any re-agent which does not decompose them. They cannot be volatilized, they cannot be subjected to any process of solution and crystallization in order to separate and purify their constituents."

Haphazard experimenting on accumulators, however careful and painstaking, seems to have done all that it can do for them, and it now awaits for theory to point out more clearly the causes of the imperfections that still exist and to indicate the conditions necessary for their elimination; or, at the worst, to show that the limits of advance in any given direction have already been practically attained.

Before attempting to decide what are the actual chemical reactions taking place in a lead storage cell, it will be as well to first see what theories have already been advanced and how they have been evolved. Planté did not pretend to go at all deeply into the chemical causes of the physical effects that he obtained. He observed the formation of lead peroxide at the positive electrode, and that the local action set up between it and the metallic lead in immediate contact resulted in the formation of lead sulphate, and, as he thought, the liberation of oxygen, but later research has shown that this is due to other causes. He also noticed the reduction of the peroxide to monoxide or litharge at the positive electrode; the oxidation of the lead at the negative electrode and the formation of films of sulphate on both; but on the whole he seems to have been inclined to ascribe the activity of the cell chiefly to occluded oxygen and hydrogen. During the period immediately following Faure's introduction of plates pasted with oxides, this view seems to have been held almost exclusively. Water, it was argued, was the real electrolyte, sulphuric acid merely being added to increase its conductivity, and on charging was decomposed into its constituent gases, which were liberated and absorbed at their respective electrodes. It was, of course, known that the first action of the oxygen was to convert all the active material at the positive electrode into peroxide, but this oxide itself was supposed to take up more gas by occlusion. The well known property possessed by palladium, platinum, and in a lesser degree by a few other metals, of absorbing oxygen and hydrogen, especially when in a spongy or porous state; Grove's gas battery; Siemens's experiments on gas batteries built up of carbon plates saturated with salts of lead;—these were the chief facts on which the theory was based, and the large capacity of a Faure cell was ascribed to the enormous surface offered by the porous mass of reduced oxides.

On discharging the cell the occluded gases recombined to form water, but it was soon perceived that the active material at the electrodes underwent some change as well, and it was thought probable that metallic lead was oxidized to monoxide at the negative, and peroxide reduced to the same substance at the positive.

$$PbO^2+H^2O+Pb=PbO+H^2O+PbO.$$

Dr. O. Lodge, in an able series of articles entitled "Electric Accumulators or Secondary Batteries," which commenced in the *Engineer* in May, 1882,[*] propounded what appears to have been the most advanced theory held up to that time. He still assumed that water was the essential electrolyte, and that the activity of the negative electrode was solely due to occluded hydrogen, and of the positive electrode during the earlier stages of discharge to occluded oxygen. The reduction of peroxide to monoxide is, however, recognized as an essential reaction, and its subsequent secondary reaction with sulphuric acid to partially form lead sulphate is also noted. A number of interesting experiments are described on the formation of "scums" or films of non-conducting sulphate at the negative plate, but this, as well as its oxidation, are supposed to only occur as its hydrogen becomes exhausted, taking the form of a crust of non-conducting materials that first appears at the surface in free contact with the liquid and gradually increases in thickness as it spreads inwards. In fact, the formation of sulphate under any circumstances is regarded as an unmitigated evil, so much so that it is expressly stated that the presence of an excess of acid in the cell must be avoided as conducing to the too easy production of this compound at both electrodes.

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[*] From *The Electrician*, London.

[†] Journal Inst. Elec. Engineers, Vol. XIX, page 699.

[*] *The Engineer*, May 16, 1882, and *seq.* Reproduced in *The Electrician*, June 10, 1882, and *seq.*

Almost contemporaneously with Dr. Lodge's articles, some others by Messrs. Gladstone and Tribe, dealing only with the chemistry of the cells, appeared in the columns of *Nature*,[*] and these, afterwards collected and published in book form,[†] contained the first data obtained by actual analyses and still constitute the most important contribution to the subject that has yet been made; for, with some comparatively unimportant exceptions, and as far as they go, their conclusions remain equally valid at the present date. They assumed that sulphuric acid, and not water, is the electrolyte, and showed by chemical analyses of exhausted plates that lead sulphate, formed by direct combination with "sulphion" (SO^4) is the normal and only product during discharge at the negative electrode, and they demonstrated that only the merest traces of the hydrogen liberated while charging are absorbed in the reduced material. Their analyses of the positive electrode proved that the peroxide was also converted into lead sulphate, most probably in two stages. In the first place, the hydrogen of the acid would reduce it to monoxide with the formation of water.

$$PbO^2+H^2SO^4+Pb=PbO+H^2O+PbSO^4.$$

Then this monoxide would re-act with the sulphuric acid with the formation of lead sulphate and another molecule of water.

$$PbO+H^2SO^4=PbSO^4+H^2O.$$

The ultimate result would, therefore, be the formation of a molecule of lead sulphate at each electrode at the expense of two molecules of sulphuric acid, which would be replaced by two molecules of water.

$$PbO^2+2H^2SO^4+Pb=PbSO^4+2H^2O+PbSO^4.$$

In addition to this it was shown that the local action between the peroxide and the metallic support was of exactly the same nature, and might be expressed by the same equation, both being converted into lead sulphate.

This new theory gave rise to considerable controversy at the time between Messrs. Gladstone and Tribe and Dr. Lodge, and very well illustrates the different points of view from which a chemist and physicist may regard the same phenomena.

To the latter it naturally seemed highly improbable that any explanation of the cell's action which involved the production of large quantities of non-conducting insoluble lead sulphate could be correct, however strong the evidence by which it was supported. Lord Kelvin and Dr. Lodge had both failed in their attempts to reduce pure lead sulphate by electrolysis with platinum electrodes in dilute sulphuric acid, although it peroxidized fairly easily; and even the best of Messrs. Gladstone and Tribe's own experiments showed that this reduction only took place after the action of the current had been prolonged for some days and then not completely. How then was it possible for the same result to be obtained in a cell in a few hours, and with a complete absorption of the current until a very small percentage of sulphate still remained to be acted upon? Messrs. Gladstone and Tribe, although they had undoubtedly proved their case, do not seem to have recognized that in putting the chemistry of the cell on a better basis they had rendered its physics proportionately difficult to understand. Later experience has shown that the conception of the distribution of the sulphate formed was largely at fault. Instead of the portion of the active material first acted upon being wholly converted into sulphate and producing a solid crust at the surface in free contact with the liquid, the action takes place more or less uniformly throughout the whole mass, owing to its extreme porosity, and leaves a nucleus of conductive material underneath, by which the current in charging is distributed to every portion of the plate. Mr. Swinburne and others have also shown that lead sulphate, when mixed with litharge, reduces easily enough, so no doubt it is very largely a matter of conductivity, but this is not a complete solution of the difficulty, and a perfectly satisfactory explanation has never yet been propounded.

Early in 1883[*] Dr. Frankland also showed that lead sulphate was the ultimate product at both electrodes, although he expressed his equations in terms of hexabasic sulphuric acid ($H^2SO^4+2H^2O$ or SH^6O^6), which he considers to be the real electrolyte. He demonstrated that neither oxygen nor hydrogen is occluded in the fully-charged plates, and drew attention to the fact that the changes in the specific gravity of the acid afforded a means of determining the amount of sulphate formed, and might be utilized in practice to indicate the degree to which a cell was discharged.

From this time onwards the double sulphating theory rapidly gained ground, although even in 1866 the late Mr. A. Reckenzaun, who was exceptionally well acquainted with all matters pertaining to storage cells, seems to have still adhered to the occluded gases theory. It is now almost universally accepted as representing the final results of discharge; but considerable differences of opinion still exist, especially with regard to the positive electrode, as to how far it is a primary electrolytic action which contributes towards the E. M. F. of the cell, and how far a secondary local reaction which is dissipated in form of heat. The chief practical outcome was a recognition of the necessity for supplying cells with stronger acid and more of it, so that the normal sulphating could easily take place without the electrolyte becoming too weak.

The corrosion or rotting of the positive grids and plates, by reason of local action with the lead peroxide, seems to have been considerably over-estimated by the early manufacturers, and Messrs. Gladstone and Tribe's researches tended in the same direction. The users of cells were warned never to overcharge them, as this was supposed to reduce the skin of lead sulphate that otherwise protected the positive support and thus promote local action.

Messrs. Drake and Gorham, however, in 1886[†] showed that the real protective coating was the dense film of peroxide into which the sulphate was gradually converted, and that some overcharging was decidedly beneficial, as it hastened the formation of this film, besides reducing any residue of sulphate that was present elsewhere. On the other hand, they found that the overdischarging then generally practised was the real cause of the excessive sulphating, buckling and local action to which the cells were so liable. These views entirely revolutionized the methods of treatment formerly adopted and put them on the basis on which they have since remained.

(*To be continued.*)

COST OF LIGHT AND POWER FOR A LARGE TEMPORARY PLANT.

BY W. F. C. HASSON AND A. M. HUNT.

The following data concerning the California Exposition and the expense connected with furnishing the necessary light and power may be of interest:

Area enclosed in the Exposition Grounds	160	acres
Buildings supplied with electric light	63	
Height of Electric Tower	262	feet
Dimensions of Grand Court	1000x500	"

Power was furnished for Exposition purposes as follows:

56	arc lights	Mechanic Arts Building
141	"	Manufac'rers' and Liberal Arts Building
112	"	Horticultural and Agricultural Building
98	"	Grand Court
160	"	Roadways, etc.
42	"	Patrol circuit
1,788	incandescent lights	Exposition Buildings and offices
2,256	" "	Cornice lights
3,212	" "	Electric Tower
1	60-inch searchlight	on Electric Tower
1	30-inch "	on Mechanic Arts Building
19	small "	for Electric Fountain

3 pumps for Electric Fountain; 2 pumps for Statuary Fountain; line shafting; fire pumps.

Incandescent lights furnished Exposition	7,256
Incandescent lights sold Exposition	1,876
Total incandescent lights	9,112

Ratio of total lights to lights sold, 4.86 : 1.

Arc lights furnished Exposition	609
Arc lights sold Exposition	182
Total arc lights	791

Ratio of total lights to lights sold, 4.34 : 1.

Receipts for sale of light and power	$26,279

Charges per incandescent lamp, period of Exposition, $8; charges per arc lamp, $75; period of operation, January 27 to July 9, 1894.

Hours of incandescent light service	1,937
Days of arc light service	154
Number of electric fountain displays	252

The machinery used for supplying power was as follows:

8 Heine boilers of 375 H.P. each. 1 Russell engine driving four 50-light T.-H. arc dynamos. 1 Buckeye engine driving four 50-light T. H. arc dynamos. 1 Payne engine driving one 50-light Standard arc dynamos. 1 N. Y. Safety engine driving one 50 and one 60-light Wood arc dynamos. 1 Ohmen engine driving three 50-light Standard arc dynamos. 1 Ball engine driving two 50-light Western Electric arc dynamos. 1 Thompson engine driving one 50-light Western Electric arc dynamo. 1 Taylor-Beck engine driving one 50-light Western Electric arc dynamo. 1 Hamilton-Corliss engine driving one 300 K. W. T.-H. A. C. generator. 1 Pitchford-Corliss engine driving one 150 K W. Wood A. C. generator. 1 Union Iron Works engine driving two 150 K.W. Western Electric D. C. generators. 1 Thompson-Corliss engine driving one 150 K. W. Edison D. C. generator. 1 Hendy engine driving one 200 K. W. Edison railway generator. 1 Putnam engine driving two centrifugal pumps for statuary fountain. 2 Hendy engines driving shafting. 3 Dow fire pumps. 3 Dow pumps for electric fountain. 3 Dow feed pumps. 1 Smith-Vaile feed pump. 1 4,000 H. P. Webster vacuum heater.

The cost of material and labor for the installation of the machinery was as follows:

Erection of boilers, pipes, pipe-covering, etc.	$17,594.33
Concrete foundation and foundation bolts for 14 engines and 6 pumps	4,459.09
Belting, shafting and sundries	2,605.89
Riggers	573.00
Office, wages and pay roll	3,787.19
Total	$29,019.5

FOUNTAIN CONSTRUCTION, ETC.

Electric Fountain.

Total expense for rental and installation of pumps, purchase and laying of pipes, all pump

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[*] *Nature*, January 5, 1882, and *seq.*

[†] "The Chemistry of Secondary Batteries." (1883.)

[*] Proc. Royal Society, Vol. XXXV (1883), page 67.

[†] British Association, 1886. *Electrician*, Sept. 19, 1886.

connections, and construction of flume and tank	$18,692.72

Statuary Fountain.

Total expense for pipes, connections, etc	1,659.89
	$15 352 61

WIRING.

Three main buildings, for 307 arc lights	$990.90
For 2,160 exterior and 1,587 interior incandescent lights	3,997.00
	$4,987.90

RENTALS.

Paid for use of boilers, engines, dynamos, wire, pole-hoods, etc	$17,528.20

EXPENSE

for material and labor of installation of electric plant:

Wire	$6,056.92	
Sundry materials	2,701.58	
Foundations for dynamos	593.47	
Office, wages, salaries, etc	5,709.40	$15,061.37

The cost of operation of the plant from January 27 to July 9, 1894, was as follows:

ENGINES AND BOILERS.

Coal, fuel oil and lubricating oil	$30,007.95
Tools, supplies and repairs	1,886.93
Office, salaries and payroll, engine plant*	13,630.50
	$45.575.38

ELECTRIC PLANT.

Carbons	$1,513.50	
Incandescent lamps	2,072.20	
Tools, supplies, etc	987.61	4,573.31

Salaries.

Office	$717.00	
Inspection	359.33	
Wages	9,257.05	10,333.38
		$14,906.69

The following was provided for by special contract:

ELECTRIC FOUNTAIN.

Contract for erection, rental and operation of same, except splash basins, piping, pumps, etc., included in other statements	$21,000.00

ELECTRIC TOWER.

Contract for rental of machinery, wiring of tower, operation of machinery and maintenance of lamps	$22,745.00

SEARCHLIGHT.

Erection of searchlight	$87.50	
Material for operation	67.05	$154.55

TOTAL EXPENSE OF INSTALLATION AND OPERATION.

Installation of engine plant	$29,019.50
Erection of fountains	15,352.61
Wiring contracts	4,987.90
Rentals	17,528.20
Installation of electric plant	15,061.37
Operation of engines and boilers	45,575.38
Operation of electric plant	14,906.69
Contract electric fountain	21,000 00
Contract electric tower	22,745.00
Expense for searchlight	154.55
	$186,331.20

The construction work of the Electrical Department, briefly stated, was as follows:

Length of underground circuits installed	17,560 ft.
Length of main pole line constructed	9,000 ft.
Lamp poles for roadways, etc	371
Incandescent lamps—wiring for	1,800
Total length of wire installed	199,267 ft.

The construction work of the Mechanical Department consisted of the unloading and handling of all machinery, the erection of all engines except two, the hanging of all shafting, the supervision of installation of all boilers, piping and pumps for fountains, etc.

The Mechanical Arts Building was so poorly designed for the purpose for which it was used that considerable labor and expense was necessary to put it in proper condition.

The chief of the Engineering Department was also chief of the Department of Mechanical Arts, which added greatly to the office expenses of that department.

The Exposition was located in a partially improved portion of Golden Gate Park.

Three-fourths of the ground consisted of sand hills on which were a few clumps of evergreens and a grove of young eucalyptus trees. The remaining fourth was swamp land, and was afterwards converted into a recreation ground and plaza for fireworks and athletic and equestrian entertainments.

The citizens of San Francisco contributed $331,000 to the Exposition fund. The original concession from the Park Commissioners was less than sixty acres. This grew to 160 acres without a corresponding increase in subscriptions.

Notwithstanding the fact that the Exposition had no aid from the General Government, State, county or city, not only were all obligations met, but a sufficient surplus remained to leave a large portion of the park permanently improved, and also a public museum and art gallery.

Minute economy in every department was essential.

Expensive underground construction was out of the question.

The distance from the dynamo to the Electric Fountain was 460 feet.

To carry the current for the fountain lights, ten 0000 cables were necessary.

The distance from dynamo to base of Electric Tower was 680 feet.

To carry the current for the tower lights, twelve 0000 cables were used.

The duct for these underground cables was built of ordinary planks, the outside dimensions being 6″x4″ and the inside 4″x2″. A continuous strip of P. & B. roofing paper was laid the entire length of the duct,—the cables placed in position, the paper folded over and both edges secured in position by the cover of the duct.

Although a large portion of the duct was under a lawn continuously saturated with water, no trouble whatsoever arose from this source.

A large portion of the wire used was 0000 cable that had been in use at the World's Fair. This wire on removal was found to be in such excellent condition that it has been sold for interior wiring for 60 per cent. of its original cost.

The ducts for underground wires for arc lights consisted of 2″x4″ rough lumber in which there was a 1″x1″ rabbet.

Lamp poles were turned 8″ diameter at base and 5″ at top—height 12′ to 14′. Wires were carried in a groove that was closed with a fillet.

Around the Grand Court arc lamps were spaced 30′ and 35′. On roadways, 50′ and 75′.

For cornice lighting a 500 volt Edison railway generator was used.

Lamps were wired in series of five and multiples of ten where the construction of the building would permit.

Edison lamps were the ones used throughout. The wiring was so arranged that the lamps on buildings nearest the power station were 117 volts; those half way around the court 115 volts; and those most distant 113 volts.

For all accessible places 16 C.P. lamps were used. For places difficult of access, on domes and minarets, 20 and 24 C.P. 120 volt lamps were used.

This policy proved to be an excellent one, as the renewals in these places were merely nominal.

The wiring for the cornice lights was done by contract by the General Electric Co.

The sockets were in place several days before the lamps were placed in position.

Through the carelessness of the inspector of wiring a great number of lamps were allowed to be placed in sockets partially filled with water. The first test of the decorative cornice lighting showed a dismal failure.

The lamps were removed, sockets cleaned, and new lamps placed in position.

Satisfactory results were obtained for a few days, when, after a heavy fog, a large number of lamps were found to be inoperative. Examination showed that in many cases the leading-in wires had been destroyed by electrolytic action.

Lamps that were found to be in good condition were then thoroughly dried at a temperature of 300° F. and the bases immersed in a bath of boiling paraffin. These lamps when placed in use withstood the weather perfectly, and the number of renewals became nominal.

The average daily load during the month of June was distributed as follows:

Arc light machines	2,156	H.P. hours
A. C. incandescent machines	2,462	“
Electric Fountain generator	2,803	“
Railway generator, light and power	2,770	“
Generators for Electric Tower lights	810	“
Fountain pumps, Electric	233	“
Fountain pumps, Statuary	480	“
Fire pumps	600	“
Feed pumps	442	“
Shafting	160	“
Starting	110	“
Total daily loads	13,026	“
Gallons of oil consumed per month	130,200	
Gallons of oil consumed per day	4,340	
Weight of oil consumed per day	32,116	lbs.
Weight of oil consumed per H. P. hour	2,465	lbs.
Cost per lb. of oil at $1.75 per bbl	56	cents.
Cost per indicated H. P. per hour of engines	1.3804	cents.
Percentage of load for incandescent lights	28.2	per cent.
Cost of fuel for incandescent lighting per month	$1,520.99	
Cost of fuel per incandescent lamp per month	16.5	cents.

The cost per 16 C. P. lamp for the period of the Exposition was as follows:

Freight on electric machinery	$ .40
Installation of dynamos	.05
Attendance of dynamos	.21
Installation of wiring	1.20
Inspection of wiring	.05
Patrol and maintenance of circuits	.03
Lamps and renewals	.30
Office expenses, Electrical Department	.06
Total Electrical Department	$2.30
Installation, engines, boilers, piping, belting and rentals	$1.32
Fuel	.825
Attendance, engines, boilers and pumps	.285
Oil, waste, etc	.01
Office expenses, Engineering Department	.05
Total Engineering Department	$2.49

Total expense of rental, installation, operation and maintenance of boilers, engines, piping, belting, dynamos, wiring, lamps, etc., per 16 C. P. incandescent lamp for the period of the Exposition	$4.79

In considering the cost of operation it must be borne in mind that the lighting plant was in no sense well designed for economic operation. Both engines and dynamos were operative exhibits that had to be matched as well as circumstances would allow.

The installation of all parts of the plant was attended with undue expense, on account of the chaotic condition of affairs incident to the necessarily rapid construction work of all departments of the Exposition.

The entire plant was of necessity regarded as an emergency plant, and so operated. The economic attendance of dynamos and engines was thus out of question.

In making the preliminary estimates of the allowance to be made for cost of lighting plant, it was found impossible to get any figures of a plant under similar conditions except the contract for lighting the World's Fair.

The results given in this article are those that were actually obtained, and it would appear that they should be of value in estimating the probable cost of work of similar nature.

It is now certain that if all construction work had been done by the Exposition forces the cost of construction would have been reduced about 35 per cent.

A suit has been brought in the Superior Court, at Tacoma, Wash., by the City of Tacoma, against the Tacoma Light and Water Company for $1,000,000 damages because of alleged fraud and misrepresentation in the sale of its waterworks and electric light plant, etc., to the city.

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*Includes all expenses for office, janitors, etc., connected with Mechanic Arts Building.

COMMUNICATIONS.

STORAGE BATTERY LITIGATION.

Concise Statement of Facts as to the Status of the Chloride Company.

To the Editor of ELECTRICITY.

DEAR SIR: In view of the publicity given to Judge Lacombe's recent decision in the case of The Accumulator Company vs. The Edison Electric Illuminating Company of New York City, directed against our chloride accumulator and based upon the Swan reissued letters patent which expire May 24, 1895, we deem a statement of facts necessary that our customers and the public generally may not be deceived or tricked into withholding orders from us through fear of litigation, or into buying the inferior batteries of the Accumulator Company and the Consolidated Electric Storage Company in the belief that they cannot procure and use, with perfect safety, our chloride accumulators which we are manufacturing and selling under an absolute guarantee to protect and save harmless all users.

This company has not been enjoined from either manufacturing, selling or using its well-known chloride accumulators, nor has any one been enjoined from purchasing or using them. The Edison Electric Illuminating Company of New York has been enjoined by Judge Lacombe from installing our chloride accumulators as a part of its central station plant simply to maintain the *status quo* pending the hearing and determination of the case in the Circuit Court of Appeals, upon the contention that the Edison Electric Illuminating Company, having simply contracted for our accumulators and not yet actually installed them, should not be permitted to do so until the questions involved in the litigation should be finally determined in the United States Circuit Court of Appeals, especially as an appeal could be at once taken to and heard in that court on the 30th of October and an early decision had thereon; and that was the view taken by Judge Lacombe and upon which he acted.

Judge Lacombe's injunction has no other effect or significance and in no way affects this company's business of manufacturing and selling chloride accumulators, or their use by purchasers, and was conditioned upon the Accumulator Company giving to the Edison Electric Illuminating Company of New York a bond in the sum of $20,000 to make good any loss which it should sustain resulting from the delay in installing our accumulators should the decision of the Circuit Court of Appeals be in favor of the Edison Company, which we are advised and believe will be the certain result of our appeal to that effect.

We are advised by our counsel and experts, among them Prof. Charles F. Chandler, of the School of Mines, Columbia College; Prof. George F. Barker, of the University of Pennsylvania; Prof. Edwin S. Houston, Pres't of the American Institute of Electrical Engineers, and Prof. Arthur E. Kennelly, of the Medico-Chirurgical College of Philadelphia, that our chloride accumulator is not an infringement of any letters patent owned by either the Accumulator Company or the Consolidated Electric Storage Company, and that in their opinion the Swan reissued letters patent are invalid and expired with the expiration of the Swan Danish patent in 1888: defences which could not be availed of by us in opposition to the motion for preliminary injunction before Judge Lacombe, they having been previously passed upon by Judge Coxe in a former decision in the same court in the case of the Accumulator Company vs. The New York and Harlem Railroad Company for the use of the so-called Julien battery, which battery was made in exact accordance with the plate of the Swan reissued letters patent, and in which our chloride battery was not involved. Judge Lacombe held that on a motion for a preliminary injunction Judge Coxe's opinion was controlling and must prevail until the consideration of the case in the Circuit Court of Appeals, when those defences would be fully heard and determined for the first time, as in the case wherein Judge Coxe sustained the Swan reissued letters patent no appeal was taken, an agreement having been made between the Consolidated Electric Storage Company, who was defending that case, and the Accumulator Company, shortly after that decision.

The facts are these, from which any intelligent reader can draw his own conclusion:

In December, 1890, the Accumulator Company brought suit against us in the United States Circuit Court for the District of New Jersey, in which we appeared and made answer and thereafter and down to the fall of 1893 no attempt was made to press the case, when it was finally abandoned owing to our positively declining to further extend the time and demanding that the case proceed to trial. The Swan reissued letters patent, upon which alone Judge Lacombe's injunction is based, were at that time owned by the Accumulator Company, although they did not include it in their suit, nor did they, after abandoning the suit, make any claim against our plate until August last, when the Edison Electric Illuminating Company of New York selected our battery for central station use in preference to any other battery in the world. Then, instead of bringing suit against us they brought suit in New York against the Edison Electric Illuminating Company, and applied for an injunction to force a temporary delay in the installation of a battery under our contract with that company. The work of preparing for the installation is going on and will be completed in time to install the battery upon the decision of the Circuit Court of Appeals, which we are confident will be favorable to us, and may be expected early in November. Swan's United States patent was applied for January 18, 1882, and was based upon an English patent to Swan of May 24, 1881, which expires May 24, 1895, at which time the U. S. letters patent will also expire—so this much-talked of suit is based upon a patent which will expire in about seven months, and obviously was brought for no other purpose than annoyance.

There is no occasion for anyone to be annoyed or intimidated by threats of litigation from the makers of these inferior and condemned batteries, for we shall continue to manufacture the chloride accumulators and furnish them under an absolute guarantee to all who require the best battery for all purposes now manufactured, and when the Accumulator Company wants to enjoin us they will have no difficulty in finding us, no more so than did the Consolidated Electric Storage Company, who brought a suit against this company in January last in the United States Circuit Court for the District of New Jersey, accompanied with a motion for injunction, which, after full preparation, was heard at great length before Judge Green, and resulted in an opinion denying the motion for injunction—which opinion speaks for itself, having heretofore been published in the columns of this journal. Since then that suit has been dismissed.

We are ready at all times to fight out any supposed charge of infringement that either the Accumulator Company or the Consolidated Electric Storage Company think they have against us, but we object to their proceeding against our customers, which obviously is for the sole purpose of annoyance and intimidation—methods which reputable business men would not countenance. Let them proceed directly against us, when if they get an injunction it will be of some value to them and the public will not be annoyed. All suits which they have heretofore brought against this company have been abandoned.

We say to our customers, and those contemplating the purchase of storage batteries, not to be intimidated or influenced by any threats of litigation, or any such public announcements as have been made based upon the above-explained decision of Judge Lacombe, as this company will stand between its customers and these attacks.

ELECTRIC STORAGE BATTERY CO.,
By W. W. GIBBS, President.

Philadelphia, October 13.

The First Electric Railway Car.

To the Editor of ELECTRICITY.

DEAR SIR: When making a search of the annals of the British Civil Engineers and Architects' Society to-day I chanced upon an account of the first electric railway car in the world.

It was invented by Mr. Alexander Davidson, of Edinburgh, Scotland, and tested on the 19th of October, 1842, on the Edinburgh and Glasgow Railway. The car was 16 feet long and 7 feet wide and was supported by four 36-inch wheels. On the trial trip ten passengers were carried, and a speed of fourteen miles an hour was attained and held for forty-six miles. The weight of car without passengers was six tons. The form of battery used was a peculiar pattern invented by Mr. Davidson, the plates being of zinc with small needle point perforations, and spongy iron; ordinary diluted sulphuric acid was used. I have the detailed account of the mechanism, but do not suppose you care for it. The *Electrical World*, some time ago, claimed that Dr. Colton, the dentist at the Cooper Union Building, invented the first electro locomotive, and I do not doubt but that the Doctor, who is a worthy man, invented and exhibited a toy locomotive in 1846; but you see the Scotsman was ahead of him.

You will have a splendid time in Atlanta, and if you needed letters of introduction I would send them to many prominent citizens, especially to members of the Capital City Club, but as I have already done all that I could to stir up my friends to treat the electric boys right, I cannot do more. As it is, the members of the Convention and the ladies of the party will receive many social attentions which are very rarely extended to visitors. Doubtless Almighty God can make a finer city than Atlanta and better fellows and handsomer ladies than live therein, but doubtless He never did. If any man who attends that Convention returns North and says that he did not have the best time in his life, you may depend upon it that he needs watching, for he will be worse than Eli Perkins, the long distance and champion liar.

The newspaper men of Atlanta are all good fellows, especially Capt. Evan P. Howell of the *Constitution*, Henry Richardson of the *Journal*, and John Temple Graves of *Dixie*. You will see them all at the social gatherings. Yours respectfully,
G. WILFRED PEARCE, C. E.

October 12, 1894.

Transmission Schemes Abroad.

(From the Electrical Engineer, London.)

In Italy.

An installation of the electrical transmission of power from Pale to Foligno is now being carried out, this being the first plant of its kind in Italy where polyphase currents will be used. The power will be obtained from the Menatre, in the proximity of Pale, and the water will be conveyed to the turbines at the generating station in Pale by means of a canal and conduits. There will be installed three turbines, each of

100 H. P., and each coupled direct from its horizontal shaft to a polyphase generator giving current at 2,000 volts. The length of the primary conductors, which are divided into two circuits, is 4.34 miles. One of these circuits will energize transformers for the supply of current for lighting purposes, and the other for motive power. The distributing station is situated in the center of Foligno. From here the high-pressure current will pass to nine transformer stations, where the current will be distributed to consumers. The electrical plant emanates from the Oerlikon Maschinenfabrik, and the turbines from the Societa Italo-Svizzera, of Bologna.

In Switzerland.

The Lucerne Municipality have appointed a commission of experts to inquire into the further utilization of water power in Switzerland for the electric transmission of power for small motors. The utilization of water power in Switzerland for the electric transmission of power is making constant headway. A large central station is being established in Wynau by Messrs. Siemens & Halske on behalf of the local authorities of Mergenthal, who will charge £4 per annum for 1 H. P., and cheaper rates for larger quantities. Another station is to be erected at Rappoldingen by Messrs. Brown, Boveri & Co. There is 2,700 H. P. available.

The United Electric Improvement Company.

The United Electric Improvement Company, whose works have been located at Gloucester City for about five years, are removing their plant to Nineteenth and Allegheny avenue, Philadelphia, where a magnificent factory building has been erected.

The Electric Storage Battery Company's plant will be in the same building.

CURRENT ITEMS.

A Ft. Worth, Tex., despatch of the 5th inst. says: "General F. M. Clarke, the inventor of a fish-shaped torpedo, left to-night for New York to complete a deal with the Chinese Government to supply the torpedoes to be used in the war with Japan. The Chinese are to pay $1,000,000, of which sum the inventor is to receive $600,000, and his partner, Colonel Fred Grant, the remaining $400,000. General Clarke received a check for $5,000 from the Chinese Government to pay his expenses in consummating the great deal. The invention is not a patent, as the chemical combinations forming the explosives are a secret known to the inventor only."

J. Howard Breed gives in the Philadelphia *Inquirer* some suggestions in regard to the handling of live wires: "When a wire is seen to fall and emit sparks any person can secure one other to assist, and then run to a nearby store for a ball of twine. Both can then walk along the street, one on each side, a long way from the wire, each holding an end of a piece of twine drawn between them. When they bring the twine against the wire so as to make it bear on the wire as high as they can reach from the ground, they can meet and one take both ends and draw the wire to one side and tie it fast to a shutter hinge or other point. If it seems best to make the string hold the wire more firmly they can pass each other and go around the wire again so as to wind the string about it, and so make it possible to pull it aside. This can be done without either person getting within forty feet of the wire."

It is a rather curious coincidence that the appearance of Mr. Hall Caine's powerful story, "The Manxman," should occur at almost the same instant as the putting into operation of the new electric railway across the quaint old Isle of Man. The road is spoken of by the London *Electrical Review* as the "most noteworthy undertaking of its kind in Great Britain." Great objection to the undertaking was raised at first by Ruskinites and hackmen; but the road is now a popular success and everybody seems delighted that wild and romantic scenery hitherto inaccessible has been brought within reach. The road is seven miles long, climbs a height of 337 feet, and is on the trolley plan, though the trolley is not an underrunning wheel, but consists of a span of wire looped at the ends and supported at each side of the car by a standard. Another feature is that midway on the line there is a storage battery plant, which charges or discharges according to the requirements of the traffic, thus helping out the power plants at either terminus. In winter it is proposed to feed from the storage plant alone, as the company is only required then to run two cars each way.

Have Opened a New York Office.

The American Electrical Manufacturing Company of St. Louis, makers of the well-known American incandescent lamps, have opened a New York office at No. 26 Liberty street. Mr. Ben Nahur, the manager of the company, will take personal charge for a few weeks.

LEGAL NOTES.

In the Superior Court at Hartford, Conn., on the 5th inst., in the case of Justin J. Gates et al. against the Waring Electric Company, of Manchester, the confirmation of William Waldo Hyde as receiver of the company was made, and he was authorized to borrow sufficient money to release the property of the defendant from attachment.

The Westinghouse Electric and Manufacturing Company has filed in the United States Court at Ft. Wayne a suit against the Ft. Wayne Electric Company, alleging infringement of the Shallenberger converter patents.

It is reported that Clarence D. Turney has been appointed receiver of the Consolidated Gas and Electric Light Company of Westchester County, whose office is at Port Chester, N. Y., by Judge Dykman, at the instance of the American Debenture Company. This is another of the companies in which the suspended firm of Coffin & Stanton were interested and Mr. Turney was the treasurer. The company had a capital stock of $500,000, and bonds of $310,000.

The General Electric Company, of New York, has brought suit against the Newtown Jockey Club to regain the electric plant supplied to the club for $8,700.

The Westinghouse Electric Company have filed a suit in the United States Court at Augusta, Ga., against the Augusta Street Railway Company and Messrs. W. E. Moore and R. J. Edenfield. The plaintiffs allege that the defendants are using and making motors which infringe patents of the Westinghouse Company.

General News.

What is Going on in the Electrical World.

Grafton, Mass.--The Grafton Electric Light Company has been awarded a ten-years contract for lighting the streets of the town.

New Castle, Ind.—The construction of an electric railway between this place and Kingstown, is being talked of and will probably be carried out.

Elmwood Place, O.—The village council has ordered that the question of issuing $30,000 bonds for waterworks and electric lighting be voted on at the regular fall election.

Hyattsville, Md.—Surveys are being made for an electric railway from Riverdale to the District of Columbia line, where the road will connect with the Eckington and Soldier's Home system.

Elkhart, Ind.—The city council has granted a franchise to the Indiana Electric Railway Company, who will build and operate an electric railway from this city to Goshen, Syracuse and Bristol.

Chicago, Ill.—The street railway companies of the North, South and West divisions of the city have applied to the city council for permits to reconstruct their respective systems with electrical equipment.

Rochester, N. Y.—The transfer of the Rochester Electric Railway to the Rochester Railway Company has been consummated and the car barns of the former company at Charlotte have been closed.

Santa Fe, N. M.—The Santa Fe Gas and Electric Company, a recent organization, have closed a contract with the General Electric Company to put in a 150 H.P. plant for lighting and power purposes.

Atlanta, Ga.—The *Journal* states that the first electric street car fitted with an air brake that has ever been brought South has been placed on cars of the Consolidated Street Railway Company in Atlanta.

Los Angeles, Cal.—It is rumored that the Consolidated Electric Company have arranged with the creditors and bondholders of the Los Angeles and Pacific to take hold of the property and make an electric road of it.

Foxboro, Mass.—The two large buildings of the Van Choate Electric Company are fast nearing completion. This promises to be one of the largest manufacturing plants in this part of the State and will give employment to several hundred people.

Cedar Rapids, Iowa.—The electric light company notified the board of public works that it would be prepared to illuminate the city streets with the new arc light system on or about the 15th of the present month. There will be 175 lights in all.

Des Moines, Iowa.—The dynamo men at the street railway power house are making a fifty horse power motor to be used on one of the big cars. With this motor the car will be able to pull one or two trailers heavily loaded and it can be used on special occasions when there is a rush.

New Britain, Conn.--The managers of the electric road are busy with plans for the extension of the lines to Hartford. A number of routes have been surveyed but as yet no definite route has been decided upon. There is a probability, however, that the line will go through to Hartford within the year.

Providence, R. I.—At the annual meeting of the Pawtuxet Valley Electric Railway Company, all the old officers were re-elected. They are: President, Nelson W. Aldrich; vice president, Henry L. Greene; directors, Gorham P. Pomroy, Charles H. Perkins, Marsden J. Perry, Arthur H. Watson, William G. Roelker.

Oakland, Cal.—The Alameda, Oakland and Piedmont Electric Railway Company has been reincorporated under the name of the Alameda and Oakland Electric Railroad Company. The intention to build to Piedmont was abandoned, and to make a complete belt-line across Oakland a new franchise was obtained.

Sacramento, Cal.—The big power house at Folsom that is to furnish electric motive power, light and heat for Sacramento, Folsom and way stations, will probably be completed within the next sixty days, by which time the work of erecting poles for the transmission of the electric current will have been about completed.

Baltimore, Md.—The Young Men's Christian Association class in electricity has opened with about twenty-five members. Mr. William H. Hall, electrician and chemist of the Polytechnic Institute, is the instructor. The classroom, in the Central Building, is rigged up with electric apparatus for purposes of demonstration.

Wabash, Ind.—The Grant County commissioners have granted the Indianapolis, Anderson, Alexandria and Marion Electric Railway a franchise for Grant County. The road is to parallel the Big Four road from Indianapolis to Marion. The company filed a bond in the sum of $5,000 to begin work June next and complete the road in October.

Waterport, N. Y.—A new company has been formed, with the title of the Empire Construction Company, to carry out the scheme of building an electric railway of the "bicycle" pattern from Batavia to Lake Side. It is said that the new company will construct a dam at Oak Orchard Creek to obtain the water power for the manufacture of electricity with which to propel the trains.

Brooklyn, N. Y.—The net income of the Edison Electric Illuminating Company for September, after deducting expenses and interest on bonds, was $12,453; for the same month in 1893, $8,515. For nine months ending September 30, the net applicable for dividends was $111,222, against $75,397 in 1893. The outstanding capital in 1893 was $2,500,000; in 1894, $2,875,000.

Austin, Tex.—The mayor has announced to the city council that the city's water and light works would be ready for operation on December 1. Two hundred and fifty miles of wire, 15,000 incandescent and 200 arc lights will furnish the city with light. Two pumps of five million gallons capacity each daily will supply water. The works, including the dam across the Colorado, have been in course of construction nearly four years.

Springfield, Ill.—The Citizens' Electric Company of this city has been granted a franchise by the council to erect a plant for the purpose of furnishing cheaper lights to the city. The ordinance provides that the company shall erect a plant capable of lighting the city with 300 arc lights of nominal 2,000 candle power, and shall add two 1,500 16 candle power incandescent alternating dynamos of the latest improvement and of first-class workmanship, and that the plant shall be in operation not later than June 1, 1895.

Albany, N. Y.—No special method of canal propulsion under the electric scheme proposed last spring has as yet been adopted, and it is doubtful if there will be any experiments made this year as the canals will soon be closed for the season. Frank W. Hawley says: "No system of electric propulsion upon the canal will be seriously considered until after the representatives of the canal boat owners have carefully investigated it and unite in its recommendation. They will be the users of the power and they must be thoroughly satisfied in the method of its application."

Harrisburg, Pa.—The Cumberland Light, Heat and Power Company, recently chartered, with a capital of $50,000, proposes to erect a plant and establish a central station at Riverton to supply the following towns with electric light: Mechanicsburg, eight miles distant, 40 arc lights; New Cumberland, three miles distant, 20 arc lights; Shiremanstown, four miles distant, 10 arc lights; West Fairview, three miles distant, 150 incandescent lights; Camp Hill, two miles distant, 200 incandescent lights; Riverton 100 incandescent lights.—In accordance with an ordinance passed by the city council of Harrisburg while in a jocular mood, tin shades have been placed on the electric lights facing suburban districts in order to prevent any portion of the territory contiguous to the city limits from being illuminated. The ordinance is the result of the refusal of the inhabitants of these districts to have their territory annexed to Harrisburg.

New York.—At the annual meeting of the Western Union Telegraph Company, held on the 10th inst., the entire board of directors was re-elected. The report for the year ending June 30, 1894, shows that as compared with 1893 there was a decrease in the revenues of $3,125,787, and a reduction in the expenses of $1,422,235, leaving the net profits lower by $1,703,733 than in the previous year.—In regard to the experiments going on at Sandy Hook to test the new device for electrical communication between anchored ships and the shore, Capt. W. S. Schley, Inspector of the Third Lighthouse District, said to a reporter a few days ago: "I can't say anything about these experiments just now, but the result will be made public in due time. When they are completed I will give an excursion for the press to Sandy Hook, and then they will be explained. We are compelled to maintain secrecy just now because we are being watched from the other side. Several governments are conducting similar experiments, and we don't want news of ours to get out until we are sure that everything is going to work properly. That assured, we shall be only too glad to make everything public."

Okonite Products.

Okonite! No word is more familiar to the electrical fraternity than this, at once the name and trade-mark of one of the most enterprising and successful industrial corporations in the United States.

In the manufacture of high-class insulated wires and cables for electric light, street railway, telegraph and telephone service, aerial, underground and submarine, the reputation of the Okonite Company, Limited, New York and London, is world-wide.

Every known precautionary measure is taken to make its products perfect in workmanship and absolutely reliable and thus maintain the original high standard of excellence which gave them instant popularity when introduced ten years ago, and which has kept them steadily at the front—recognized leaders.

All the copper wire used is of the highest grade, drawn true throughout and inspected in every particular before leaving the factory at Passaic, N. J., and tested for all possible faults during the various stages of manufacture into insulated wires and cables. The same careful attention is extended to all other departments, only skilled labor being employed and much specially designed machinery being used.

For street railway feed wire purposes, Okonite has proved a most efficient and profitable insulation. It is tough and durable, will not crack when exposed to the severest changes in temperature and has the highest of insulating qualities. Eminent electrical engineers with large experience in the electric railway field endorse Okonite insulated wire strongly, and once used it is generally a permanent fixture in the equipment of the plant.

For electric lighting, telegraph and telephone service, the Okonite wires and cables are standard goods. Miles on miles are used annually in this class of work, both in this country and abroad, for it must be remembered that the business of this concern is not confined to the United States only, but extends throughout the Continental countries of Europe, a branch establishment at Manchester, Eng., supplying the trade abroad.

Other Okonite products are the "Manson" and "Okonite" tape for making water-proof joints, etc., popular beyond measure for the work intended.

One who has been closely identified with the rise of Okonite products and the fortunes of the Okonite Company Limited is Capt. Willard L. Candee, one of the original promoters of the business, and at present one of the American directors. The "Captain," as he is popularly referred to, has a genial personality and his enterprising business management has contributed largely to the attainment of the enviable position occupied by the Okonite Company Limited among the industrial concerns of to-day.

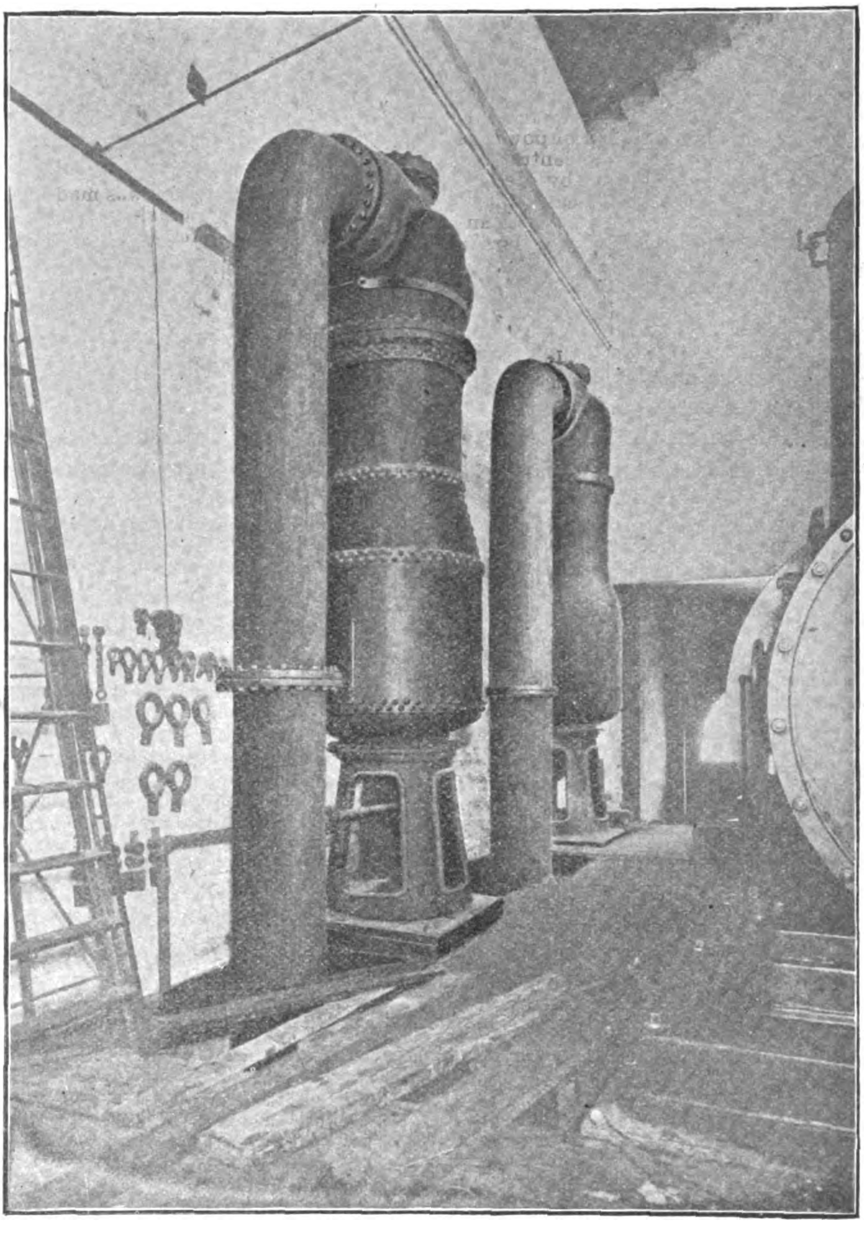
Stratton Separators for the Philadelphia Traction Company's Plant at Philadelphia.

The illustration shows two of a total of six Stratton Steam Separators, all of more than usually large size, recently furnished by the Goubert Manufacturing Company, New York, to the Philadelphia Traction Company for their new power stations at 13th and Mount Vernon streets, and 33d and Market streets, Philadelphia.

The Goubert Company has become famous for the number of large separators and feed water heaters it has built, and this latest installation takes rank with any already noticed, if indeed it does not exceed in the individual size and aggregate number all previous installations to which we have from time to time drawn attention. Of the six Stratton Separators in the Philadelphia plant, two are 18-inch, two 16-inch and two 8-inch. One of the 18-inch Separators is seen in the foreground of the engraving. The almost general adoption of the Stratton Separator by large electric lighting and power companies for important stations lends more than passing interest to a brief review of its construction and claims to merit as a saving agent wherever steam power is employed.

The Stratton Steam Separator is based upon the principle that if a rotative motion is imparted to the steam all the liquid particles it may contain, being heavier than the steam, acquire centrifugal force and are projected to the outside of the current.

It consists of a vertical cylinder with an internal central pipe extending from the top downward for about half the height of the apparatus, leaving an annular space between the two.



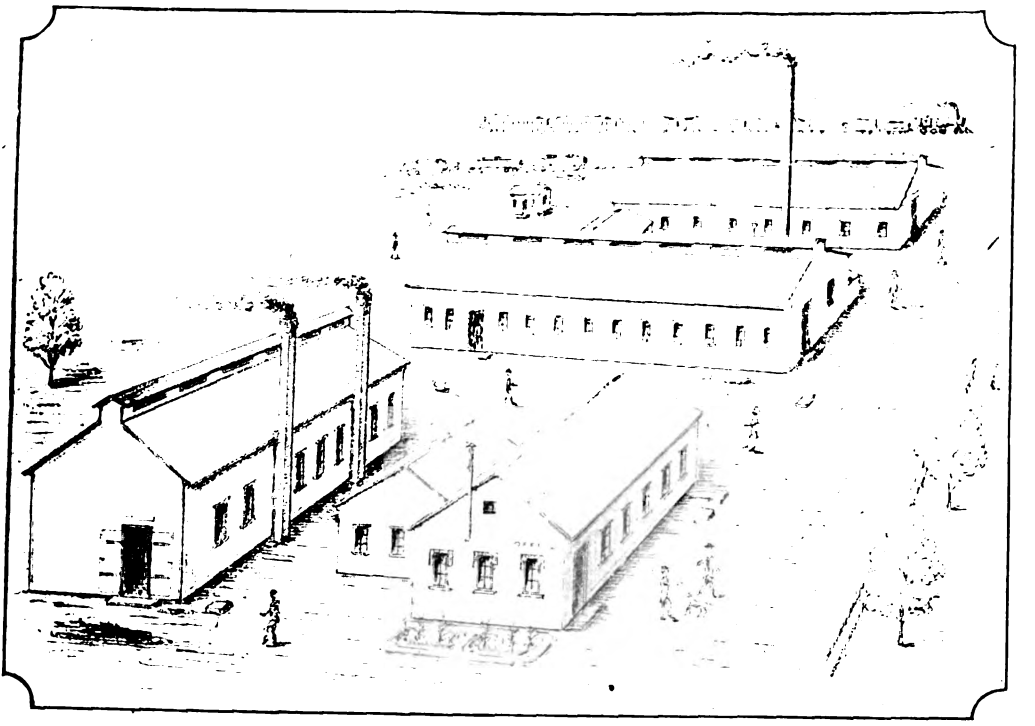
Stratton Steam Separator.

A nozzle for the admission of the steam is on one side, the outlet being on the opposite side or on top as may be most convenient in making the connections. The lower part of the apparatus is enlarged to form a receiver of considerable capacity, thus providing for a sudden influx of water from the boiler. A suitable opening is tapped at the bottom of the apparatus for a drip connection, and a glass water gauge shows the level of the water in the Separator at all times. The current of steam on entering is deflected by a curved partition and thrown tangentially to the annular space at the side near to top of the apparatus. It is thus whirled around with all the velocity of influx, producing the centrifugal action which throws the particles of water against the outer cylinder. These adhere to the surface, so that the water runs down continuously in a thin sheet around the outer shell into the receptacle below, while the steam, following a spiral course to the bottom of the internal pipe, abruptly enters, and in a now dry condition passes upward and out of the Separator, without having once crossed the stream of separated water, all danger of the steam taking up again such water after separation being entirely avoided.

It is of interest to add that the Goubert Manufacturing Company has also supplied Goubert Feed Water Heaters o the latest improved type for the new plants of the Philadelphia Traction Company, aggregating 12,000 horse power

The Partridge Carbon Works.

One of the few independent carbon companies which have been successful from the first day of business is the Partridge Carbon Company of Sandusky, Ohio.



Partridge Carbon Works, Sandusky, Ohio.

The active members of the concern, Messrs. Partridge and Speer, are both old-timers in the electrical line, the former having been connected with Mr. Charles F. Brush in his earliest practical work, and subsequently having performed important services for the Brush Company abroad.

They pay little attention to lighting carbons, turning out almost exclusively motor brushes, which are in use with good results on nearly all the leading roads in the country.

Their factory has been full of business all through the long period of general depression.

The success of this company is due chiefly to the long practical experience of Messrs. Partridge and Speer in carbon making and their knowledge of the wants of the trade.

Westinghouse Stopper Lamps.

The Westinghouse Electric and Manufacturing Company have bought the land and are soon to build a 14-pot glass furnace on Lacock street, Allegheny, where bulbs for the stopper lamps will be made. The present furnace will be completed, according to the contract, by November 1. The company is now making lamps at the Exposition Building, where they have an excellent plant, but it cannot be used after the close of the Exposition. The Allegheny furnace will have a capacity of 20,000 lamps a day.

Paper Cable.

The Norwich Insulated Wire Company, of 44 Broad street, New York, have issued a neat and convenient catalogue covering all their various sizes of cables for Electric Light and Power, Telegraph, Telephone, Railway, Submarine, and Police and Fire Alarm Cables.

The Norwich Company's product is in the front rank, and prospective purchasers will do well to read the interesting matter contained in this catalogue.

How to Use Micanite.

An important point in making or refilling Commutators is the necessity of applying heat during the process of building, and from long experience the following method is guaranteed by the Mica Insulator Company, 218 Water street, New York, to give perfect satisfaction, and be a cure for such ills as loose bars, cement oozing out, or oil soaking in, if Micanite Segments or Rings are used.

After assembling the Commutator, heat it to about 200° F. or just enough to make the Micanite pliable, then tighten the bars or rings as much as possible. The pliability of the Micanite will allow the distribution of unequal strains and will counteract to a great extent irregularities in the dimensions of other parts of the Commutator. Then continue the heating, but this time let it reach 400° F., or until the shellac, which will have oozed out here and there, becomes dry. In fact the shellac may be partially carbonized with no bad results. Then retighten the Commutator either hot or cold, but preferably in both states. Do not tighten during the progress of this second heating, but wait until the shellac is baked dry.

When no proper arrangements are provided for heating, the Commutator can be put for a few minutes inside a boiler furnace door, or on a gasoline stove, or on a plate placed over a blacksmith's forge.

If this method is followed out in all cases, both with the Micanite Segments and Rings it will be found that a Commutator so built is extremely firm and satisfactory in every respect.

INCORPORATIONS.

The Faraday Electric and Chemical Company, Kittery, Maine—to manufacture and deal in electrical and chemical, machinery. Capital stock, $150,000. Promoters: W. W. Jacques, Newton, Mass.; Belle L. Ruggles, Reading, Mass.; Jas. H. Flanagan, Boston, Mass.

The Keystone Electric Street Railway Company, Philadelphia—to construct, maintain and operate an electric street railway. Capital stock, $180,000. Promoters: Thos. W. South, Chas. P. Tomlinson, Philadelphia; Frank F. Bell, Bristol, Pa.

The Clifton Park Passenger Railway Company, Baltimore—to build an electric railway. Capital stock, $50,000. Incorporators: Winfield J. Taylor, Alfred J. Ulman, James H. Smith, Davies Murdoch, Frank N. Hoen, Robert S. Carswell and Eben B. Hunting.

The American Electrical Heating Company, Detroit, Mich. Capital stock, $50,000.

The Philadelphia and Neshaminy Electric Railway Company, Philadelphia—to build a line of railway. Capital stock, $75,000. The incorporators and officers are: President, Chas. P. Tomlinson; directors, Wm. Miller, Chas. A. Porter, Frank F. Bell, Henry Van Brunt, Thomas Shallcross, Thomas W. South.

The Peekskill, State Camp and Mohegan Railroad Company has been incorporated at Albany—to operate a street railroad (trolley) from Peekskill to Lake Mohegan, with branch roads in the towns of Cortlandt and Yorktown. Capital stock, $175,000. Directors: F. C. Beach, E. B. Gallagher, C. E. Hammond, G. M. Bailey and G. F. Kunz, all of New York City; G. D. Hiscox, of Brooklyn, and H. L. Armstrong, T. D. Husted and J. B. Westbrook all of Peekskill.

The Orange Lake and Walden Electric Railroad Company, Newburg, N. Y.—to build a railway to be a continuation of the Newburg and Orange Lake Railway and terminate at Walden. Incorporators: Benjamin Norton, Brooklyn; H. C. Norton, H. R. Newkirk, B. B. Odell, Jr., Col. William D. Dickey, Capt. Joseph M. Dickey and Major W. H. Weston, Newburg.

The Cook Elevated Electric Railway Company, Chicago. Capital stock, $10,000,000. Incorporators: Mark Sands, James E. Gaule and Carl H. Leopold.

The Thompson-Brown Electric Company, New York City—to deal in electrical machinery, apparatus and supplies. Capital stock, $25,000. Directors: George Thompson, Jr., Oyster Bay; Maybin W. Brown, Hyde Park, Mass., and Ernest F. Ayrault, of New York City.

The Northern Allegany Telephone Company—to establish a line extending through the villages of Hume, Fillmore, Canadea, Rushford, Houghton, Belfast and Angelica, N. Y., where it will connect with the main line of the Western New York and Pennsylvania Telegraph and Telephone Company. Capital stock, $3,000. Incorporators: Charles Ricker, J. R. Hadnett, L. S. Geiser and W. S. Mills, of Fillmore; M. S. Bartlett, Canadea; I. S. Hunt, Belfast, S. M. Norton, Friendship.

The Hestonville and Overbrook Passenger Railway Company, Philadelphia, Pa.—to construct, maintain and operate an electric railway. Capital stock, $5,000. Promoters: Johns Hopkins, Isaac Blum, Simon J. Martin, Philadelphia.

ELECTRICAL PATENT RECORD.

Letters Patent Issued October 9, 1894.

ELECTRIC RAILROADS AND APPLIANCES.

527,126. Electric Locomotive. Nicolas J. Raffard, Paris, France, assignor to the Thomson-Houston Electric Company, of Connecticut. Filed July 23, 1891. Renewed April 13, 1894.

527,244. Electric Locomotion on Railways. Jean J. Heilmann, Paris, France. Filed April 20, 1894.

527,265. Conduit System for Electric Railways. William A. Butler, New York, N. Y., assignor to John Gilmore, Boyd, same place. Filed April 20, 1894.

527,294. Track-Switch for Electric Railways. Augustin F. Schinner, Milwaukee, Wis. Filed June 16, 1894.

527,301. Conduit Electric Railway. James E. Toole, Northumberland, Pa. Filed Jan. 24, 1894.

527,355. Trolley-Wire Support or Hanger. Sam C. Woodhead, Philadelphia, Pa. Filed April 24, 1894.

ELECTRIC LIGHTS AND APPLIANCES.

527,211. Electric-Arc Lamp. Max Mayer, New York, N. Y., assignor to the Auerbach-Woolverton Electric Company, of New Jersey. Filed June 18, 1894.

527,228. Electric-Arc Lamp. John E. Woolverton, New York, N.Y., assignor, by direct and mesne assignments, to the Auerbach-Woolverton Electric Company of New Jersey. Filed Feb. 9, 1894.

527,229. Electric Arc Lamp. John E. Woolverton, New York, N. Y., assignor to the Auerbach-Woolverton Electric Company of New Jersey. Filed April 13, 1894.

527,285. Incandescent-Lamp Socket. Luke R. Peck, St. John's, Mich., assignor of one-half to Robert G. Steel, same place. Filed April 10, 1894.

MOTORS, DYNAMOS, ETC.

527,066. Device for Protecting Separately-Excited Generators. Benjamin G. Lamme, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, same place. Filed Feb. 28, 1894.

527,070. Electrical Converter. James W. Packard, Warren, Ohio. Filed Jan. 3, 1894.

527,075. Running Compound-Wound Dynamo-Electric Machines in Multiple. William B. Potter, Schenectady, N. Y., assignor to the General Electric Company of New York. Filed June 2, 1894.

527,127. Commutator Brush-Holder. George Rauch, Milwaukee, Wis. Filed April 28, 1894.

527,195. Alternating-Current Motor. Carl Coerper, Cologne, Germany. Filed May 15, 1894.

527,225. Adjuster for Field-Magnets of Dynamo-Electric Machines or Motors. Montgomery Waddell, Bridgeport, Conn., assignor to Montgomery Waddell, receiver of the Waddell-Entz Company of West Virginia. Filed Sept. 6, 1893.

527,379. Apparatus for Generating Electricity by Solar Heat. Melvin L. Severy, Boston, assignor of one-half to Francis Doane, Norwood, Mass. Filed Feb. 16, 1894.

BATTERIES.

527,298. Electric Battery. Milton E. Smith and Maurice F. Geer, Rochester, N. Y., assignors of one-third to Paul C. Brewer, same place. Filed March 29, 1894.

TELEPHONE AND TELEGRAPH APPARATUS.

527,214. Telephone Transmitter. Thomas McCoubray, New York, N. Y. Filed Aug. 16, 1894.

SIGNALS AND SIGNALING APPARATUS.

527,257. Electrical Signal. Harry H. Wister, Colorado City, Colo. Filed April 10, 1893.

527,258. Signal-Recording Device. William H. Adkins, Rome, Ga. Filed Dec. 29, 1893.

527,267. System of Electric Block-Signals for Railways. William M. Cuthbert, Brooklyn, N. Y. Filed Feb. 16, 1893.

MISCELLANEOUS.

527,050. Dynamic Electric Heater. Herman B. Collins, Fulton, assignor of one-half to Warren H. Boles, Syracuse, N. Y. Filed Sept. 22, 1892.

527,071. Electrical Fuse Box. James W. Packard, Warren, Ohio. Filed Jan 3, 1894.

527,092. Circuit-Controller for Regulators. Barton B. Ward, New York, N. Y. Filed Oct. 13, 1893.

527,098. Railway-Annunciator. Charles R. Alsop, Middletown, Conn., assignor to Lucy C. Alsop, same place. Filed Nov. 2, 1893.

527,099. Electric Track Signal. Charles R. Alsop, Middletown, Conn., assignor to Lucy C. Alsop, same place. Filed Nov. 27, 1893.

527,110. Method and Apparatus for Electrodeposition of Metals. Charles R. Fletcher, Boston, Mass. Filed June 20, 1894.

527,150. Electric Ore-Amalgamating Apparatus. John C. Ludwig, San Francisco, Cal. Filed March 5, 1894.

527,177. Electric Switch. Raymond S. Kelsch, Chicago, Ill. Filed May 28, 1894.

527,254 Insulator. William D. Trimble, Baltimore, Md. Filed Feb. 2, 1894.

527,293. Railway-Switch. Augustin F. Schinner, Milwaukee, Wis. Filed March 28, 1894.

527,317. Insulator. Edward J. Bullock, Wallingford, Conn. Filed Nov. 27, 1893.

527,318. Insulator Pin. Edward J. Bullock, Wallingford, Conn., assignor of one-half to Merwin D. Tuttle, same place. Filed Feb. 9, 1894

527,324. Electric Heater. Jesse R. Davis, Parkersburg, W. Va., assignor of one-third to Charles A. Wade, same place. Filed Feb. 24, 1894.

527,375. Thermostat. Lewis G. Rowand, Camden, N. J., assignor to the Universal Fire Alarm Company, same place. Filed June 5, 1893.

527,377. Apparatus for Mounting and Operating Thermopiles. Melvin L. Severy, Boston, assignor of one-half to Francis Doane, Norwood, Mass. Filed Feb. 16, 1894.

527,378. Apparatus for Utilizing Steam for Heating Thermopiles. Melvin L. Severy, Boston, assignor of one-half to Francis Doane, Norwood, Mass. Filed Feb. 16, 1894.

527,393. Busy-Test for Multiple Switchboards. Robert H. Polk, Savannah, Ga. Filed April 20, 1894.

ELECTRICITY.

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EDITORIAL NOTES.

General Electric. A ripple of interest has been created in the affairs of the G. E. Company by the recent slump of 4 points in the price of the common stock.

There is apparently nothing in the condition of the company, more than there has been any time the past year, to warrant any change in the market, either upwards or downwards.

The cause of the recent decline seems to have been Mr. Coffin's selling out his own actual holdings, using for this purpose his friend, Mr. Weil, who has for several months been very close to Mr. Coffin in all his speculative ventures.

This lends considerable strength to the opinion that Mr. Coffin is getting ready to retire before the first of the year—an opinion which has been held for some time by his enemies in the company, who are already planning what they will do when he is finally out of the way.

As to the much-talked-of reorganization, it looks now as though it would be put off until the next annual statement is made up; in any other event, there would need to be two jobs of scaling down, as this year's business will show a further deficit of about $8,000,000 in addition to the $12,000,000 of the last report. It is probably the part of wisdom to make one job of it all, as nothing can be lost by the delay and a good deal can be gained by those directors who are manipulating the stock continually.

It appears that Mr. Coffin again got the best of his New York associates last week, Mr. Twombly having unwittingly or otherwise taken the stock which Weil was selling for Coffin.

* * *

THE G. E. Co. are pushing their monocyclic system very hard nowadays. The value they place on it is shown by a recent sale in Sparta, Wis., of a 150 H. P. monocyclic generator for $1,500, or $10 per H. P. What price do the Edison licensees receive on this type of machine?

* * *

THE picture of a man who was hanged in Atlanta a few months ago was printed by mistake in the *Journal* of that city on Wednesday last as a portrait of Mr. M. J. Sullivan of the *Electrical World*.

The Booster System. One of the special papers read at the Atlanta Convention on the use of the booster system for electric railways suggests a remedy for a very common fault in such roads with long branches necessarily running a good way from the power station. On quite a number of such roads there has already been experienced the difficulties due to a fall in voltage as the distance from the power house increases, and these difficulties are quite serious where the drop is very large. This condition means that either the speed of the cars is materially reduced or the amount of current consumed by the car is far in excess of the capacity of the motor winding, and consequently burnouts are frequent. There are only two ways to remedy this trouble, one being to increase the amount of copper on such lines until the drop is the same all over the system, and the other is to raise the voltage at the distant points by some auxiliary apparatus. Where the travel on a road of this kind warrants it, the use of sufficient copper to avoid a heavy drop is apparently the most simple and desirable remedy, but in a great many cases the extra investment involved in this is not warranted by the receipts of the line, and in these cases it is only a question of supplementing the pressure in some way or incurring the expense of frequent burnouts at such points.

The paper by Messrs. Vail and Wynkoop relates to the use of the booster for such lines, and there appears to be no reason why this plan should not prove as useful in the case of railroad work as it has already shown itself to be in electric lighting regulation. The chief use of such a system would be in cases where difficult grades are encountered at the further ends of long lines, and a similar case was successfully remedied by storage batteries some time ago. On the road in question a considerable grade occurred at the end of a long branch, and at that point the pressure fell from 500 volts at the station to about 375 volts. To avoid the frequent burnouts here the line was fed by a battery of accumulators which maintained the standard voltage at this grade. As far as the burnouts and speed of the cars were concerned the trial proved entirely satisfactory. The booster system, which is simply a dynamotor wound to raise the pressure to the required amount, acts in the same way as the batteries described above, and its use in many places would undoubtedly save a large amount of copper and avert much of the trouble which is often met at points where the drop is excessive.

* * *

Valuable Information. Our brilliant and enterprising contemporary, the *Electrical World*, devotes five and one-half columns of its issue of October 20 to "Flywheel Accidents in Power Stations," wherein a baker's dozen of gentlemen well known in electrical and mechanical circles tell us over their own signatures substantially that flywheels usually break because they are not strong enough. Now that the enterprise of the *Electrical World* has given these experts the opportunity of telling us this, we see that their conclusions must be correct, and wonder that we had not thought of it before. This feature of the *World* attracted a great deal of attention at Atlanta, as it had previously been the contention among some steam users that flywheels broke because they were too strong. The most valuable contribution to this collection of opinions, however, is that contributed editorially, that the "*destructive strains* are rather to be ascribed to *centrifugal* than to *tangential* stress," etc. Here is a chunk of wisdom that is calculated to astonish the mechanical world quite as much as the recent announcement in the same journal did the mathematical world: "That if our system of linear units were based on π the ratio of the circumference of a circle to its diameter would be unity." The latter statement re-echoed round and round the world. We expect this new engineering discovery to revolutionize the flywheel industry so that hereafter flywheels will be built or so operated as to develop no centrifugal force, but only tangential stress.

* * *

No OTHER feature of the General Electric's original policy proved so flat a failure as the attempt to force consolidations in all large towns. A deal of this kind was made in Rochester. Now the independent Citizens' Light and Power Co., started a few months after the consolidation, is doubling its capacity, rates are being cut wide open—*and the town is not bottled up.* How many successful local combinations are left?

Of Course We Were.

(From the Chattanooga Times.)

Thus the visitors were in that respect the richest, as they were in appearance and dress the neatest and the best looking body of men that has visited Chattanooga in many a day.

A simple device for electrically regulating the feeding of horses has been patented by Amos Y. Reeder, of Philadelphia. Each of the stalls is connected by a tube to the supply box above and at the end of each tube is the electric apparatus which controls the flow. This is done by working on two cut-offs, which allows just the right quantity of grain to drop into the feed box. A single touch of a button will feed a stable full of horses. This can be attached to a clockwork arrangement, which will automatically feed the horses at any given time. This device is a great boon to milkmen, bakers and those similarly employed, as it permits them to sleep while the animals are feeding.

The Atlanta Convention.

Rousing Meeting in the Gate City of the South.

The Proceedings in Detail.

The Thirteenth Annual Meeting of the American Street Railway Association was held in Machinery Hall, Piedmont Park, Atlanta, Ga., October 15 19, 1894.

President Henry C. Payne, of Milwaukee, Wis., called the meeting to order and introduced Hon. W. J. Northen, Governor of Georgia, who extended a cordial greeting to the delegates and visitors. After reviewing the progress of street railway development in Georgia, the Governor concluded: "We welcome you again because you represent the greatest factor for civilization known to the Northern world. You have enhanced the value of this great country of ours more than any other half dozen factors for producing wealth that have been in operation for the last quarter of a century. You broaden out cities, you scatter the density of population, you make it convenient for the professional man, for the business man and for the laboring man to go from his home to his work with the least expenditure of time.

"How can we stand in the presence of such an organization, the members of which have for their object such high purposes, without bowing in the highest possible appreciation of their work, and saying that Georgia and the South give you a most cordial welcome?"

President Payne fittingly acknowledged Gov. Northen's welcome on behalf of the Association.

Letters of regret at their inability to be present were read from past Presidents Chas. B. Holmes and Henry M. Watson.

The first order of business was the reading of the minutes, and on motion they were approved.

The president read his address, in which he thanked the Association for its partiality in electing him to that office. Continuing he said:

"It is hardly necessary for me to say that since our last meeting the street railway business has suffered, in common with all other enterprises, owing to the financial stringency and business depression which have prevailed in all parts of the country. These conditions, however, have not been without lasting benefit to the interests which we represent. I think we have all studied more thoroughly to bring about economies in operation, to limit the construction of new lines into unproductive territory, and in every way to bring our business to a more healthy basis; so that, from that point of view, there is compensation for the depression through which we have passed. I presume it is the common experience of all that we are on the up-grade, and I confidently anticipate a slow but gradual return to normal business conditions. The resources and characteristics of the American people are such that they cannot long continue in a state of either mental or financial depression.

"During the transition period from animal to electric power on the tramways of our country, it was but natural that the proceedings of the annual meetings of the Association should be largely taken up with the consideration of the application of electricity to transportation purposes. Now that we may fairly consider such application as an accomplished fact, I think our attention should to a greater degree be turned to a comparison of views regarding the practical operation of our several roads. The substitution of electricity for animal power has elevated the business to a higher plane. Street railways have become as essential to the prosperity of our metropolitan cities as the steam railways to the country at large."

After referring to the business to be transacted the president closed his address with a tribute to the memory of Mr. Wm. Richardson, of Brooklyn, and Mr. Wm. J. Stephenson, of Washington, D. C., deceased during the past year.

The report of the Executive Committee was next presented. The report, commenting upon the business depression which has existed, said: "The fact is there is no more accurate test or measure of the state of the business of the country than the varying income of a street railway company. Business in general during the last year has been bad, and the street railway business in particular has suffered, several of our member companies having gone into the hands of receivers, while consolidation still continues to be the trend of the times. While the year has been a hard one the business outlook is encouraging, and we look forward with confidence to a successful year's business."

The report enumerated a number of changes which had taken place in the membership—the present number being 184 companies, exclusive of additions at the Atlanta meeting.

Reference was made to the special reports to be presented as covering a wide range of subjects and expressing the latest thought and practice in the business; and the Committee touched upon the subject of the exposition of street railway supplies, which was fast becoming a prominent feature.

A list of judicial decisions published during the year was given, and it was stated that the second volume of "American Street Railway Decisions" would be issued to subscribers during November.

The report further said: "Two proposed amendments, one to the Constitution, the other to the By-Laws, are herewith submitted, and, though it would not be binding in any sense, we should be pleased if a vote were taken at this meeting, without debate, that we might ascertain whether the judgment of the Association is in accord with that of your Committee on both subjects.

"The proposed amendment to the Constitution is to provide for the admission of individuals, and companies not street railways, as associate members, under certain conditions, such character of membership having been found conducive to the general welfare of kindred associations.

"The proposed amendment to the By-Laws has in view morning sessions only; providing for less exhaustive meetings; for more opportunity for social enjoyment, as well as for opportunity to examine the display at the Exposition, which has become so important a feature of our annual meetings."

On motion of Mr. Littell, the report was received.

The report of the treasurer was presented, and showed the financial transactions of the year to have been:

Receipts	$8,290.79
Expenses	8,196.72
Balance	$94.07

On motion of Mr. Bean, the report was approved.

A communication from the Georgia Electric Light Company was read, extending an invitation to the delegates to visit their plant.

The first committee report presented was on "The Best Method of Treating Accidents and Complaints." The report was presented by Mr. P. M. Dyer, claim agent of the West Chicago Street Railroad Company.

The report was a description of the method employed by the North and West Chicago Street Railway Companies. The working force consists of a medical staff and a sufficient number of investigators, all under the direction of the chief adjuster, who reports to the general counsel of the two companies. The work of the claim department may be divided into three periods—investigation, negotiation and litigation.

The details of procedure in case of accident, in regard to procuring testimony, locating witnesses and adjusting damages, were then given. The officers of these companies believe in the thorough investigation of all accidents; if possible, the settlement on a reasonable basis of all valid claims; in vigorously contesting fraudulent demands; and that prompt settlements are for the best interests of their companies.

The next business was the report on "A Uniform System of Street Railway Accounts," by Mr. H. I. Bettis.

Mr. Bettis's report related to a systematic classification of expenditures and receipts for which he gave a number of blank forms. The object of such a system is to keep an account of the cost and income of every department of a street railway separately and to establish a uniform method of keeping such accounts, so that the published statements of the same could be directly compared. He considers that if administrators of American railroads could see their way to adopt a more uniform method of compiling their published accounts, setting forth the particulars of capital authorized, raised and expended, revenue earnings and disbursements, assets and liabilities, on defined principles, and in a manner intelligible to any ordinary man of business, it would tend greatly to improve the value of sound railway securities. Were there a more uniform system of reports and accounting, there is no doubt that the stock and bonds of our wonderful street railway properties would find an open market abroad.

The secretary announced that upon the adjournment of the meeting the Convention would inspect the exhibits; that at 4 o'clock a visit would be made to the car house of the Atlanta Consolidated Street Railway Company, and from 6 until 9 o'clock a reception would be tendered to the delegates and ladies accompanying at the Capital City Club. On motion, adjourned.

Thursday's Session.

An Executive Session was held on Thursday morning by order of the Executive Committee. The subject of Transfers and Commutations was discussed, the general impression being that the privileges should not be extended further than is absolutely necessary.

The subject of the formation of a Street Railway Mutual Fire Insurance Company was also taken up, and on motion of Mr. Russell F. Harrison the incoming officers and Executive Committee were appointed a committee to report on the subject.

On motion of Mr. Littell, of New Orleans, Messrs. Littell, Perrine and Connette were appointed a committee to wait upon the officers of the Underwriters' Association of the South with a view to securing better conditions and rates for insurance of street railway properties, the office of the association being in Atlanta. The Executive Session then adjourned.

The paper "Can the T Rail be Satisfactorily Used in Paved Streets" was then read by Mr. Hendrie.

The paper, which was a brief one, argued decidedly in favor of the T rail, and was supplemented by a list of roads using the track from which favorable reports had been received. The main consideration in the case of this rail is to make the paving job a neat and good one.

On motion of Mr. McLean, the following gentlemen were appointed a committee to nominate officers and select a place for the next meeting: Messrs. McLean, Connette, McNamara, Baumhoff, Breed, Semmes and Rugg.

Letters inviting the Association to hold its meeting in their respective cities were presented in behalf of Cincinnati, O., Philadelphia, Pa., and the invitation extended at the Milwaukee meeting by Mr. Usher, of Montreal, for the Association to hold its meeting in the latter city in 1895, was read by the secretary.

Friday's Session.

President Payne called the meeting to order at 10:30 a. m.

The first business was the report of the Committee on City and Suburban Electric Railways, by Mr. E. C. Foster. The report, which chiefly considered the relative advantages of city and suburban roads, dealt with the requirements of each and differentiated between the necessities of city and suburban service. It is apparent that suburban roads work at a disadvantage compared with city roads when the question of operating expense is considered. There are many reasons why a given number of cars can be operated for less money within a small territory than when spread over a large area. These reasons are obvious. In the former case a large number of cars may be cared for in one car-house, thus allowing a minimum expense of maintenance. A small car-house cannot afford the motor tables, traveling cranes, etc., that do so much to lessen the cost of motor and truck repair, nor can the work of the small house be divided among different men, giving each his specialty, as in a large house.

The subject of long distance transmission on suburban roads by the use of high tension currents was also considered by the author, and several advantages as well as some drawbacks are recited. He says:

"While this system has many advantages which are sure to result in its extensive application, it has its attendant disadvantages which must be overcome. Most important of these is the difficulty of insulating the lines. Practice has been to use bare wire, simply because the covering is of no use with such voltages. The principal use of the insulation on the majority of overhead wires is a sentimental one. The public prefers the appearance of the covering to the bare wire. It is probable that it will be wise to recognize the existence of this preference, and cover the wires merely to save comment. The most serious difficulty, however, lies in the fact that it seems to be absolutely necessary to keep the wires out of the trees. Mr. George D. Johnson, superintendent of the Hartford Electric Light Company, writes that a twig short circuits their 5,700 volt mains almost as readily as a wire."

On motion the report was ordered to be printed in the Proceedings.

The report on "The Rail Construction of the Terre Haute Street Railway Company" was read by Mr. Harrison and was followed by considerable discussion. The construction in question is of T rails and, as with almost any rail, the joints are the main consideration. In concluding the discussion, Mr. Harrison stated in regard to expansion and contraction: "My experience is that there is so much metal down below the surface, where it is cool, and so little of it exposed to the heat, just the head—we have no grooved or girder rail in our city—and just a little on one side, that we do not suffer from contraction and expansion as in the case of a girder rail. The joints are the Wheeler joints and rest on the tie, and then we tamp the rail up with concrete, not only the ties supported with concrete, but under the rails also, and the concrete comes up over the tie, so that the rail and the tie both rest on solid concrete, with a heavy bed below, and when the brick paving is put on and all cemented together there are practically no joints and you cannot feel them in passing over the rail. It gets no wear and tear, and that is why, in economy of operation, it is superior, because there are no joints to rattle a car in passing over them. Our motors and cars last longer and we have better service.

A letter from G. T. Crosby was read, regretting his inability, owing to pressure of business and absence from the country, to present a report on "Standards for Electric Street Railways." On motion of Mr. Perrine, the Committee on Standards was continued.

M. K. Bowen, superintendent of the Chicago Street Railway, sent a communication recommending that a committee be appointed to investigate the subject of the validity of patented articles used by street railways. Mr. Perrine moved that a committee be appointed on this subject, which motion was carried.

The matter of the proposed amendments to the Constitution and By-Laws to provide for associate members was then considered. An informal vote was taken as to the advisability of the adoption of the amendments; and it was the unanimous judgment of the members that the amendments should be adopted. Action on the same will be taken at the next annual meeting.

The special committee appointed to interview the representatives of the Underwriters' Association of the South reported that they had been unsuccessful in meeting such officials.

Mr. Brophy, of Boston, president of the New England Reserve Fund Association, was introduced and said in part: I think it would be better for each State Association of Street Railways to make application to the board of underwriters of the mutual companies which control its territory. I think something might be done in the way of securing a reduction of rates. Our company is not a stock company. We have no agents and pay no premiums, so that we can afford to carry the business at somewhat lower rates. Ours is the only mutual company which is at the present time carrying electric light and railway properties. We have been insuring electric light stations and power houses for two years, and car houses for one year. We have at the present time $7,000,000 of property of this class, and for the last ten or twelve months, ending October, our losses have been $2,300 on the $7,000,000. We have been able to pay a dividend of 70 per cent. on business written one year ago. We have been insuring this character of business for two years. I state this to show you that the electric business is not so hazardous as some people think it is. (Applause.) It can be insured at a profit. We have paid some losses; at the same time we have paid to our policy holders forty per cent. of the premiums paid. The premiums collected have paid losses and expenses and left a balance to be returned to policy holders, so that the business is not so very bad. Our rates on electric light stations is 1 per cent., which calls for a station which is a model in every way. We do not ask for cement floors or iron floors, nor do we ask that the roof shall be eighteen feet high; but we want a plant that is clean and has no oil on the floors, no finish on the walls, and no attics or basements. If it has a basement or second floor, used for storage, they must be equipped with automatic sprinklers. Our experience has been with car houses very satisfactory. We do not know just where the losses will be, but our premiums so far have met all expenses. Our expenses for inspectors have amounted to 6 per cent. of premiums received, and the total expense, including losses, is 12 per cent.

Mr. Seely—In relation to insurance companies, the members of the National Electric Light Association had the same trouble that you are laboring under, and I believe the company which Mr. Brophy represents came to their relief. I have no doubt that the street railway companies could get substantial relief in this direction by a conference with the representatives of the mutual companies. The Standard Oil Company carries its own insurance, has a profit every year, and there is no reason why this great business should not do likewise. We could establish a mutual company of our own, and have a central office.

The motion to appoint the special committee was then put and carried. The president appointed as such: Messrs Harrison, Terre Haute; Dyer, Augusta; Perrine, Trenton; Lusher, Montreal; Bamhoff, St. Louis.

Mr. Perrine offered the following resolution:

Resolved, That the Executive Committee is hereby requested to take under consideration the question of the enlargement of the field and scope of the Association, and submit a plan, suggesting ways and means therefor, at the next meeting of the Association. Carried.

The Nominating Committee then presented the following report: President, Joel Hurt, Atlanta, Ga.; Vice-President, W. Worth Bean, St. Joseph, Mich.; Second Vice President, John M. Cunningham, Boston, Mass.; Third Vice-President, Russell B. Harrison, Terre Haute, Ind.; Secretary and Treasurer, William J. Richardson, Brooklyn, N.Y.; Executive Committee: Henry C. Payne, Milwaukee, Wis.; W. H. Jackson, Nashville, Tenn.; D. G. Hamilton, St. Louis, Mo.; G. C. Cunningham, Montreal, Canada; J. N. Partridge, Brooklyn, N.Y.

The committee recommended Montreal, Can., for the next meeting.

On motion, Mr. Penington, of Chicago, was instructed to cast the ballot of the Association for the officers nominated.

This was done and they were declared duly elected.

Mr. Penington moved that Philadelphia be substituted for Montreal as the place of meeting.

A spirited discussion ensued over the question, and during the calling of the roll there was much interest manifested. The vote when taken stood: Montreal, 38; Philadelphia, 17.

Mr. Cunningham, of Montreal—Gentlemen: I wish to say a few words to you to show how very pleased indeed I am to know that next year Montreal will receive this large and important Association. I can assure you that we will do everything in our power to remove any difficulties that may exist as to entering any supplies for the purposes of exhibition. I can confidently promise you that there will be no difficulty in bringing supplies to Montreal any more than there was in bringing them to Atlanta. We recognize in Montreal, as well as do the residents of other places, that this exhibition, which is a part of the annual meetings, has become a very important feature and should be maintained and improved, if possible, every year; and therefore, for that reason, I can promise you that we will do all in our power to remove any difficulties that may exist in coming to Montreal. You will receive there a most warm and hearty welcome. (Applause.)

The report of the Committee on "Mail, Express and Freight Service on Street Railway Cars" was then read by title only, and on motion was ordered to be printed in the Proceedings. The report of the Committee on Transfers and Commutation was also read by title and accepted.

The report of the Committee on the "Use of the Booster on Electric Railway Circuits" was next in order, and after a few remarks by Mr. Vail, giving the substance of the paper, was ordered to be printed in the Proceedings.

The report is printed in full elsewhere.

Mr. Hurt, the newly elected president of the Association, then addressed the Convention. Referring to his election he said: I thank you sincerely for this honor. I have not sought it, but I appreciate it none the less. I assure you that I shall not take up your time in making a speech. I am fully in accord with those who have the interests of this Association at heart, and I shall do my best during the year to come to further its advancement. I can do no more than ask your co-operation, free consultation and help in every direction. The Executive Committee, of course, will have certain important matters before them, but with your secretary must lie the main weight, and I have no doubt that he will in the future, as he has in the past, discharge his full duty. I feel that this Association is entering an era of much more useful work than has marked its past career. Its scope should be enlarged. There are many features of the work devolving upon the managers of street railways in which they need help from this Association; and this should have your special attention during the next twelve months.

The report on "Destructive Arcing of Five Hundred Volt Fuses" was read by title, and ordered to be printed in the Procedings.

The paper on Brake Shoes was read by title, and was ordered to be printed.

Mr. Davis—In accordance with the recommendation of the paper, I move that a committee be appointed, to consist of two members of the Association and one manufacturer, to investigate the subject of the adoption of a standard style of brake-shoes, conduct experiments, and report the data collected, and its conclusions, at the next meeting, without expense to the Association. Carried.

The report on "Power Brakes vs. Hand Brakes," by E. J. Wessels, was read by title. It was ordered printed.

The special paper by Allen R. Foote on "Taxation" was read by title, and ordered printed. The meeting then adjourned to meet in Montreal next October.

THE EXHIBITORS.

The exhibits in the main hall of the Exposition Building were equal to those of any previous Convention, and the facilities for the show were never better. The following is a list of the companies who were represented by one or more hustlers:

Lewis & Fowler Mfg. Co., Brooklyn, N.Y.
Central Electric Heating Co., New York.
Lederle-Taylor Co., Atlanta, Ga.
Quaker City Car Equipment Co., Philadelphia.
Walker Manufacturing Co., Cleveland, O.
J. G. Brill Co., Philadelphia.
R. Woodman Mfg. and Supply Co., Boston.
Georgia Equipment Co., Atlanta, Ga.
Sterling Supply and Manufacturing Co., New York.
E. F. de Witt & Co., Lansingburg, N.Y.
Falk Manufacturing Co., Milwaukee, Wis.
General Agency Co., New York.
Genett Air Brake Co., New York.
Wm. Wharton, Jr., & Co., Inc., Philadelphia.
Consolidated Car Heating Co., Albany, N. Y.
Wadhams Oil and Grease Co., Milwaukee, Wis.
Fairbanks, Morse & Co., Chicago.
H. B. Cutter, Philadelphia.
Webster & Beach, New York.
Brooklyn Car-Wood and Veneer Works, Brooklyn, N. Y.
"Street Railway Review," Chicago.
"Street Railway Journal," New York.
"Electricity," New York.
"Street Railway Gazette," New York.
"Electrical World," New York.
"Electrical Review," New York.
"Electrical Engineer," New York.
"Electrical Age," New York.
"The Car," Philadelphia.
"Electric Power," New York.
Washburn & Moen, Worcester, Mass.
Wells & French Co., Chicago.
Johnson Co., Johnstown, Pa.
Jackson & Sharp Co., Wilmington, Del.
Laconia Car Co., Laconia, N. H.
Morris, Tasker & Co., Philadelphia.
McGuire Manufacturing Co., Chicago.
Charles G. Smith, New York.
Leonhardt Pneumatic Safety Car Fender Co., Baltimore.
New Process Raw Hide Co., Syracuse, N. Y.
Pettingill-Andrews Co., Boston.
Pomeroy & Fisher, New York.
Pennsylvania Steel Company, Philadelphia.
Quaker City Equipment Company, Philadelphia.
John Stephenson Company, New York.
Holmes, Booth & Haydens, Waterbury, Conn.
Chicago Rawhide Manufacturing Co., Chicago.
Geo. C. Dressel & Co., New York.
Bushnell Manufacturing Company, Easton, Pa.
Fulton Truck & Foundry Co., Cleveland and Mansfield, O.
C. J. Field, New York.
Storm Manufacturing Co., Newark, N. J.
Harris Life Guard, Boston.
St. Louis Register Co., St. Louis.
Card Electric Co., Mansfield, Ohio.
Weston Electrical Instrument Co., Newark, N. J.
New Haven Car Register Co., New Haven, Conn.
The Ohio Brass Co., Mansfield, Ohio.
American Electrical Works, Providence., R. I.
Creaghead Engineering Co., Cincinnati.
Benedict & Burnham Mfg. Co., Waterbury, Conn.
Dreher Manufacturing Co., New York.
Dorner & Dutton Mfg. Co., Cleveland, O.
Electric Railway Equipment Co. Cincinnati.
Fairburn Engineering Co., Chicago.
E. S. Greeley Co., New York.
John A. Graham & Co., New York.
Hooper & Townsend, Philadelphia.
International Register Co., Chicago.
Johns-Pratt Co., Hartford, Conn.
American Car Co., St. Louis.
Anniston Cordage Co., Anniston, Ala.
American Iron and Bolt Co., Cincinnati.
P. and B. Manufacturing Co., New York.
American Electric Mfg. Co., St. Louis.
Abendroth & Root Mfg. Co., New York.
American Engineering Co., Atlanta, Ga.
Brownell Car Co., St. Louis.
Binghamton Wagon Co., Binghamton, N. Y.
Barney & Smith Co., Dayton, O.
Buckeye Engine Co., Salem, O.
Carnegie Steel Co., Atlanta, Ga.
Chicago Electric Truck Co., Chicago.
G. L. Colgate Co., New York.
R. A. Crawford Mfg. Co., Pittsburg.
Composite Brake Shoe Co., Boston.
Car Equipment Co., Philadelphia.
Beacon Lamp Co., Boston.
Columbia Lamp Co., St., Louis.
Partridge Carbon Co., Sandusky, O.
St. Louis Car Co., St. Louis.
W. R. Brixey, New York.
R. D. Nuttall Co., Allegheny, Pa.
Westinghouse Electric and Mfg. Co., Pittsburg, Pa.
Baltimore Car Wheel Co., Baltimore.
Rochester Car Wheel Works, Rochester, N. Y
Siemens & Halske, Chicago.
Hale & Kilburn Mfg. Co., Philadelphia.
Paige Iron Works, Chicago.
Chas. A. Schieren & Co., New York.
Niles Tool Works Co., Hamilton, O.
R. A. Crawford, Pittsburg, Pa.
American Railway Supply Co., New York.
New York Insulated Wire Co., New York.
Arthur S. Partridge, St. Louis.
Bass Foundry and Machine Works, Fort Wayne, Ind.
General Electric Co., New York.
Maxwood Brake Shoe Co., La Crosse, Wis.
Meaker Mfg. Co., Chicago.
Heine Safety Boiler Co., St. Louis.
H. W. Johns Mfg. Co., New York.
Davis Car Shade Co., Portland, Me.
Estes & Lowe, Macon, Ga.
New York Electrical Works, New York.
H. J. Wightman & Co., Scranton, Penn.
Luiburg, Sickel & Co., Trenton, N. J.
Bragg Fender Co., Troy, N. Y.
Jewell Belting Co., Hartford, Conn.
Eddy Electric Mfg. Co., Windsor, Conn.
Scarritt Furniture Co., St. Louis.
H. C. Bruner, Pontiac, Ill.
Pomeroy & Fischer, New York.
Electrical Installation Company, Chicago.
Standard Underground Cable Co., Chicago.
R. W. Hollis, Atlanta, Ga.
S. M. Balzer, New York.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
International Register Co., Chicago.
Berlin Iron Bridge Co., East Berlin, Conn.
Charles L. Cornell, Hamilton, O.
Wallace Electric Co., Chicago.
Fuel Economizer Co., Matteawan, N. Y.
Technic Electrical Works, Philadelphia.
Stilwell-Bierce and Smith-Vaile Co., Dayton, O.
National Lock Washer Co., Newark, N. J.
Flood & Conklin Co., Newark, N. J.
Kohler Brothers, Chicago.
Mason Electric Co., Chicago.
The Electrical and Mechanical Engineering and Trading Co., New York.

THE SOCIAL SIDE.

The Shenandoah Valley Special.

The special train which carried the majority of the Eastern delegates and supply men left New York at 3 P. M. on Monday, the 15th, and made the run direct to Atlanta, without delays or mishaps of any kind. The train was under the personal supervision of Mr. L. J. Ellis, the courteous agent of the Norfolk and Western Railway, who looked closely to the comfort of his guests until they landed in the Jersey City depot at the end of the return trip. There were on board this train upwards of 100 happy people, to most of whom the ride through the poetic Southern country was a novelty.

The roster was as follows :

L. Perrine, Jr., Trenton, N. J.
R. S. Woodruff, "
S. B. Thompson, Baltimore.
H. E. Hurley, Trenton, N.J.
C. J. Field, New York.
H. S. Wyman, New York.
W. Wilkinson, New York.
H. J. Crowley, Shamokin, Pa.
J. R. Beetem, Scranton, Pa.
T. E. Crossman, Brooklyn.
W.R. McAdoo, Paterson, N.J.
F. E. Huntress, New York.
F. H. Sloane, Baltimore.
R. M. Rose, Norwood, Ct.
E. E. Higgins, New York.
W. H. Linburg, Trenton, N.J.
F. G. Fulton, New York.
Chas. R. Vincent, New York.
E. Packer, New York.
R. H. Beach, Boston.
W. E. Boughton, New York.
C.A. Schieren, Jr., Brooklyn.
Edgar Peckham, New York.
J. H McGraw, New York.
B. E. Greene, New York.
E. B. Hatch, Hartford, Ct.
Mr. and Mrs. W. T. Hunt, New York.
Mr. and Mrs. W. P. Seguine, New York.
E. J. Wessels, New York.
Geo. S. Whipp, Brooklyn.
C. L. Tolles, Hartford, Conn.
H. C. Evans, New York.
W. S. Silver, New York.
S. N. Stevenson, New York.
J.H. Stedman, Rochester, N.Y.
Mr. and Mrs. J.H. Blackwell, Trenton, N. J.
C. A. Benscotter, Knoxville.
Mrs. Ellis, Atlanta, Ga.
W. G. Eno, Wilkesbarre, Pa.
John Graham, "
R. F. Outcalt, New York.
T. G. Fuller, New York.
C. A. Bradley, Waterbury, Ct.
A. O. Shepardson, "
W. W. Cole, Elmira, N. Y.
Mr. and Mrs. J.A. Seely, N.Y.
E. T. Landon, New York.
J. H. Woodward, New York.
G. W. Pierce, Stamford, Ct.
C. M. Clark, Scranton, Pa.
John F. Ostrom, Steelton, Pa.
P. C. Ackerman, New York.
E. S. Goodrich, Hartford, Ct.
H. Pearson, Springfield, Mass.
Wm. F. Acton, Norwood, Ct.
Mr. and Mrs. W.J. Richardson, Brooklyn, N. Y.
D. Coolidge, Johnstown, Pa.
J. A. Hanna, Philadelphia.
Frank H. Ball, New York.
E. H. Allen, Philadelphia.
George F. Porter, New York.
Jas. W. Perry, Philadelphia.
E. D Meier, St. Louis.
J. R. McCardell, New York.
E. J. Lawless, New York.
L. Greenwood, Jr., New York.
R. O. Heinrich, Newark, N.J.
Walter Hunt, New York.
E.L. Ross, Ind'n Orchard, Mass.
J. T. Smith, Fishkill, N. Y.
H. J. Winser, New York.
M. E. Baird, Windsor, Ct.
Mr. and Mrs. W. J. Johnston, New York.
W. H. Taylor, New York.
Mr. and Mrs. Edmund N. Smith, Philadelphia.
Wm. E. Cooke, New York.
E. V. Faucett, Philadelphia.
T. C. Martin, New York.
L. J. Ellis, New York.
B. F. Myers, Harrisburg, Pa.
H. J. Eno, Wilkesbarre, Pa.
Mr. Holleback "
H. H. Luscomb, New York.
William Granten, New York.

This train arrived at Atlanta on time, while the Pennsylvania Company's train experienced considerable delay and was over two hours late, much to the disgust of the fifteen or twenty delegates who had the bad judgment to choose that route.

The Entertainment.

No city has ever entertained her electrical guests so royally as did Atlanta, and the week will be pleasantly remembered by the hundreds of visitors. Every one was made aware at once that the townspeople had surrendered themselves for the time being, and that the strangers owned the city. Nothing, however, was carried away, except a few bales of cotton, some cannon balls, and other relics of the time which neither Southern man nor Northern man cares to dwell on thirty years after the event.

On Tuesday morning all were advised that the courtesies of the Capital City Club and the Piedmont Driving Club were extended to the pilgrims, and on Wednesday evening there was an informal but brilliant reception given at the former club, which the flower of Georgia beauty and Southern eloquence rendered delightful and instructive.

On Thursday evening the official banquet of the Association was given at the Kimball House, of which so much cannot be said with truth. There were several hundred guests at table, but the responses were in the main dry and prosy, for which there was no excuse, as no one should have felt at all dry. Mr. J. H. Stedman, of Rochester, presented the only redeeming bit of brightness in his set of verses, but Mr. Stedman could not be dry if he tried.

Friday afternoon the entire body attended a glorious barbecue at Ponce de Leon Springs, which was a novel experience for nine out of ten of those who gorged themselves to fulness on roasts of mutton and pork not measured by the pound, and on Atlanta beer which was only measured by the keg. Many gentlemen amused themselves here by throwing coins to the gathered throng of darkies, and the scramble to get them seemed to indicate that money was ordinarily none too plenty among them.

In the evening there were innumerable theater parties, closing the series of entertainments. Here again beauty was out in force, and we only hope that they have retained half the good opinion of Northern men which the latter carried away with them of the women of Atlanta.

The Return Trip.

The Norfolk and Western special left at 11 o'clock on Friday night, arriving at Chattanooga early Saturday morning. Here excursions were made to the historic environs of the city, Lookout Mountain and Missionary Ridge, where Generals Hooker, Thomas, Bragg and Longstreet earned fresh laurels, and where the graves of 12,000 men testify to the bravery alike of the Union and Confederate soldier.

Leaving Chattanooga on Saturday night, further stops were made at the Natural Bridge and Luray Caverns, and the party arrived in New York on Monday morning, voting without a dissenting voice that the Atlanta Convention was the greatest success in this line up to date.

A few stragglers were left in Atlanta on Saturday, the last remnant, a party of four gentlemen, winding up the week in a blaze of glory about five minutes before the last train left for the North on Saturday night.

From Other Cities.

There were many other car-loads of pilgrims from St. Louis, Chicago, etc., all of whom, we have no doubt, enjoyed themselves equally as well as the New York and New England parties, and will be eager for the time to come again when they can once more visit Atlanta under like conditions.

Thanks to Mr. Ellis.

On the return trip of the special train a handsome cane and a brief set of resolutions, expressing the appreciation of his party, were presented to Mr. L. J. Ellis.

A Well-Merited Compliment.

Industries and Iron, a London publication, pays the following compliment to the management of the American technical societies :

" American technical societies have the knack of managing their affairs extremely well. Their proceedings are printed in a first-class manner, and are copiously illustrated, while the matter is quite up to the average of the best of our English institutions dealing with similar departments of applied science. Letter ballots are in vogue, and everything seems to be done to ensure as little waste of time as possible. One feature might with advantage be adopted in this country, although perhaps some of the members would strenuously oppose it, and that is, the posting of the names of those in arrears, with dues, fees or subscriptions, for the benefit of the members as a body."

Northwest G. E. Wound Up.

Have Byllesby and Coffin Fallen Out ?

The following circular letter partially explains itself :

Chicago, October —, 1894.

Dear Sir : The General Electric Company, for the purpose of further simplifying its organization, has abandoned its office in St. Paul, and all business heretofore conducted through that office will hereafter be handled from its office in Chicago.

During the past four months all orders for supplies sent to the St. Paul office have had to be forwarded to and filled from the Chicago warehouse, so that this change will save a delay of at least twenty-hour hours on each order. It is therefore evident that the wants of customers can be cared for more promptly and satisfactorily under this arrangement than the old.

Salesmen will visit you from the Chicago office from time to time for the purpose of furnishing information, prices, etc., concerning this company's manufactures.

All communications should be addressed "General Electric Company, Monadnock Building, Chicago, Ill.," except remittances, which may be sent direct to Schenectady, N. Y.

We ask for a continuation of your valued patronage, and are sure that this arrangement, made in the interest of a more satisfactory filling of orders, will meet with your cordial approval. Yours truly,

B. E. Sunny,
Western Manager.
Arthur S. Huey,
Late Manager of St. Paul Office.

It is not surprising that this office has been closed, but the manner in which it was done was a surprise to the few employes who remained, none of them, not even Mr. Huey, having been informed of the plan until the night before the office furniture was packed up. There had not been a single profitable contract closed in the territory for a year.

The former employes received one month's salary. One or two of them were offered positions with the Chicago office, under the conditions, however, that they would take their residence outside of the former district of the Northwest General Electric Company, but would be permitted to go into this territory to get orders.

CURRENT ITEMS.

In a new process for coloring leather by electrical action, the hide is stretched upon a metallic table and covered, except at the edges, with the coloring liquid. A difference of potential is established between the liquid and the metallic table. The effect of the electric current is to cause the pores of the skin to open, whereby the coloring is enabled to penetrate deeply into its tissue.

An electric railway is to be built from Mercer, Cal., to Yosemite, seventy miles.

Two thousand three hundred and twenty-one people took interest enough in scientific matters to attend the recent annual meetings of the British Association at Oxford.

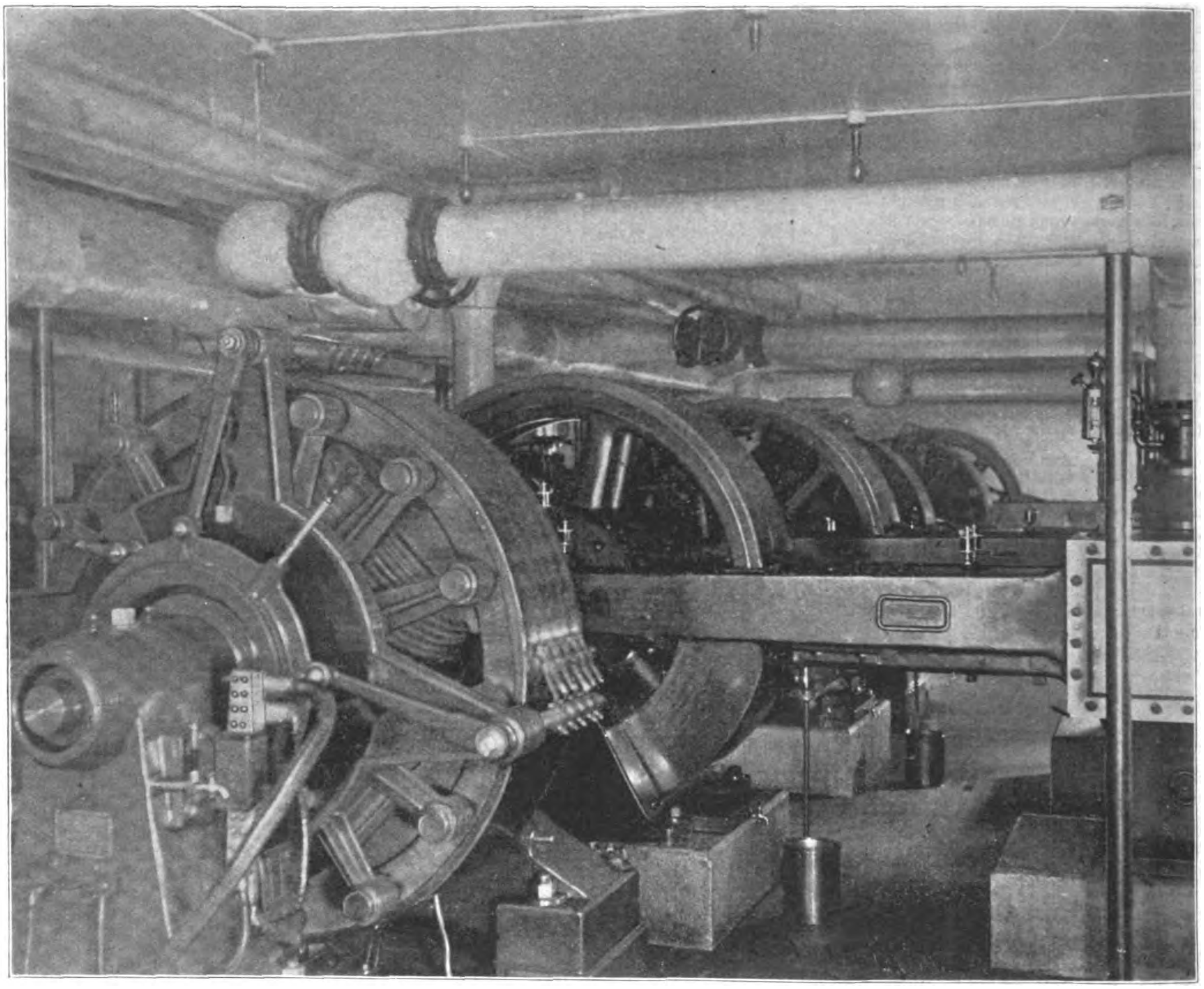
The Elektricitäts-Gesellschaft, of Frankfort-on-the-Main, Germany, have acquired a large site near Plettenburg, in order to erect a central station for the electric transmission of power to Lüdenscheid, Plettenburg, Werdohl and Herscheid. It is also intended to light the streets by electricity, and to supply current to an electric tramway. At Metzingen a project has been brought forward for electric transmission of power in connection with the existing central electric lighting station.

At a recent meeting of the Sugar Planters' Association in New Orleans, a paper from a Northern electrician was read accompanied by samples of sugar showing that it was very possible to refine sugar by electricity. The samples sent had been treated by being boiled through a bag; boiled down in open pan; no purging, no boneblack and no molasses left. He claimed the cost could be materially reduced. By the elimination of all nitrogenous substances from melted sugar by electricity and aluminum he was able to polarize 99 per cent and crystallize the entire syrup.

A MODEL ISOLATED PLANT.

Electrical and Steam Equipment of the New York Mutual Life Insurance Building.

The use of isolated plants for lighting and power purposes in the large office buildings of New York has become so general that very few of them contain any special features which have not already been described and illustrated in the technical press, but we find in the Mutual Life Insurance Building a plant which, in its mechanical and electrical construction and compactness, ranks among the very best of its kind, and surpasses by reason of its simple and complete engineering details many of the lighting and power plants that are to be found in buildings of a similar character. The features of this equipment which will appeal to the engineer are the class of machinery used, the excellence of the construction work and the careful records which are kept of the performance of the plant.



Siemens & Halske Plant, Dynamo Room, Mutual Life Building, New York. (Fig. 1.)

The boiler room contains four Babcock & Wilcox boilers of 125 horse-power each and one of 300 horse-power, giving a total steam capacity of 800 horse-power. These are run at 100 pounds pressure and a daily record of their work is made, the coal and ashes being always weighed, and the feed water metered. They are fed by two Worthington duplex pumps 6" x 6" x 4" in dimensions.

The engine and dynamo room, which, by the way, is innocent of any trace of the usual oil and dust found in almost every room where machinery is used, is a long, narrow room one-half of which lies under the court between the old part of the building and the new Liberty street annex. It is 73 feet in length and 26 feet wide, but in spite of its limited area contains four direct-connected engines and dynamos, for which the space is more than ample. Three of these units are shown in Fig. 1, and the fourth, not shown, is in line with those illustrated.

The engines are of the Straight Line type, simple, non-condensing, with 15½ inch cylinder bore and 16 inch stroke. Their capacity is 200 horse power each, and they run at a speed of 230 revolutions per minute. Directly connected to each engine by means of an insulated coupling is a Siemens & Halske dynamo of 100 K.W. capacity, of the internal four-pole type. The fields of these machines, which are compound wound, are centered on the line of the engine shaft and are surrounded by an armature of the Gramme ring type, having 720 commutator bars, corresponding to the same number of armature coils. The core consists of the usual laminated soft iron rings, and each armature coil is formed of a single turn of pressed copper the outside surface of which forms the commutator. The general design of these dynamos, which are now too well known in this country to require minute description, will be readily seen from the illustration in Fig. 1. These machines were furnished through Mr. C. D. Shain, of New York, and have proved more than satisfactory to the engineering department of this building. In this plant the dynamos are run up to 800 amperes each and the pressure at the switchboard is 110 volts.

The wiring of the building is also a feature which deserves special attention. Habirshaw wire has been used throughout and is run entirely in interior brass-armored conduit. On each floor of the building a cut-out box is placed at the point of distribution for that floor, and these are supplied from five main feeders which are distributed as follows: two for the Nassau street building, one in the Cedar street annex, and two in the Liberty street annex, all of which are of 1,000 amperes capacity.

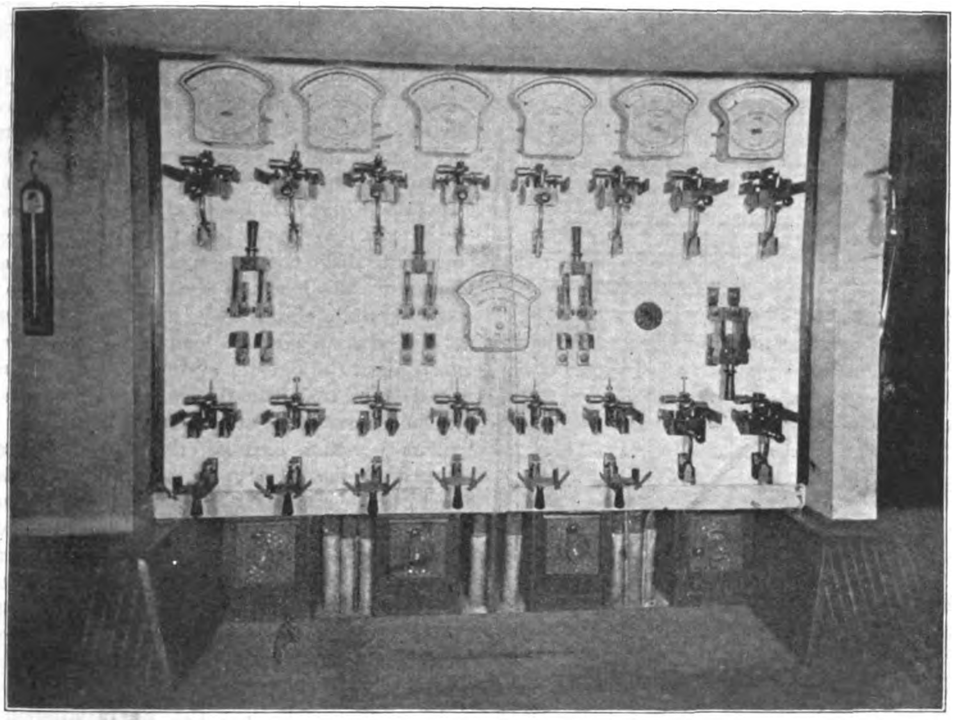
The switchboard, which is shown in Fig. 2, is made of white marble and equipped with Weston standard station ammeters and voltmeters. The upper row of instruments shown on the board is connected with the five feeders mentioned above, and beneath each instrument are situated automatic cut-outs to protect each feeder circuit. The center of the board contains a main voltmeter, and the leads from each dynamo are provided with automatic cut-outs which are shown along the bottom of the switchboard. Below these are four rheostats for regulating the voltage of each dynamo.

The wiring of the building and the switchboard was done by Mr. Geo. H. Prido, of New York, and has proved to be a most thorough piece of construction as no faults whatever have been developed since the work was first installed. The plant is designed to supply 7,500 incandescent lamps, of which 5,600 have been already wired.

Besides the lighting the current is also used to run six electric motors which lift the dumbwaiters in the restaurant of the Insurance Club, who occupy the 13th, 14th and 15th stories of the Liberty street annex. The motors are about 4 horse power, taking 30 amperes each.

In the rear of the dynamo room a photometer is placed for testing the candle-power of all new lamps purchased, and in each new lot every tenth lamp is tested as soon as unpacked. The bases and sockets used through the building are the Bryant patents, which were first put in by the United States Company.

The records of the performance of the plant are kept with great precision, the engineer in charge making hourly reports to the chief engineer, who tabulates these reports for every hour during the day. The sheets on which these are made out give the curve of lamp-hours for each day, with the average number of lamps in use, number of replaced lamps, and the number of hours run by each engine and dynamo. These records are afterwards transferred to a book which contains the entire performance of the plant since it was installed.



SWITCHBOARD, MUTUAL LIFE BUILDING, NEW YORK. (FIG. 2.)

In addition to the lighting plant the building also contains a very extensive hydraulic plant for running eleven passenger elevators and two sidewalk lifts and a hydraulic ram for hoisting safes.

There are also a number of house pumps among which is one that supplies water from an artesian well, 709 feet deep, and a stationary steam fire engine built by Clapp & Jones, of the same pattern as those used on several of the fire boats. This can deliver water at the rate of 800 gallons per minute, at 150 pounds pressure, at any part of the building.

C. K. COOPER, CHIEF ENGINEER.

The entire engineering work in the building is under the direction of Superintendent J. F. McKim and Chief Engineer C. K. Cooper. Besides the New York building, Capt. McKim has charge of all the company's buildings in a number of cities throughout the country. Mr. Cooper, who gives this work his personal supervision, was born in New York in 1846, and after serving as a volunteer in the late war was apprenticed to Faraday & Sons, in Baltimore. After this he spent nine and one-half years at sea service in engineering work and then several years with R. Hoe & Company, of New York, and N. B. Cushing, of Jersey City, in the same capacity. He next spent seven and one-half years as chief engineer to the Bloodgood estate, and in 1885 was employed by the Mutual Life Company, for which he has since been made chief engineer.

The Use of the Booster on Electric Railway Circuits.*

BY J. H. VAIL AND S. H. WYNKOOP.

The question of investment in copper is one which has always been a bugbear to the street railway manager, and is to-day the most serious problem confronting the operating company, inasmuch as it tends to restrict the extension of long distance lines for serving suburban traffic. Since the cost of copper for a given service increases directly as the square of the distance, the necessary investment becomes prohibitory when the line extends more than three or four miles from the station.

Railway generators and motors are becoming more satisfactory; we are still allowed, in the absence of a conduit system inspiring confidence, to suspend our trolley wires overhead; and in some cities the authorities will look the other way while we string cables as large as hawsers from pole to pole, in pairs, in dozens, and—if poles could be found to stand the strain—probably in scores.

Even then we are not happy. The power-house site is usually chosen, so far as circumstances will permit, with reference to convenient coal delivery and the distribution of traffic. In the heart of the city crowded streets render slow speed imperative; in the suburbs, where a clear track invites to rapid transit, the pressure is low—usually abominably so. In fact, the writers have in mind a city not far from the metropolis where two motor cars are run upon a single car's time; and they have witnessed the *fading out* of the electric headlights as the two cars started out together. The reduced voltage was in this case self-evident; and the net horse-power secured to move the cars was *probably less than half the proportionate amount originally generated* in the station. The loss in transmission does not require further demonstration.

Accurate tests show that the commercial efficiency of the street railway motor at normal voltage is 78 per cent., while at two-thirds of the normal it is only 52 per cent. We all undoubtedly recognize the fact that the resultant effects of too little copper show up to the non-expert traveling public in slow speed and dimming of lamps; but to the railway company the results *are actual losses*—decreased traffic and increased coal bill; which is the direct opposite of what we desire. In other words, instead of aiming at the greatest receipts for the least expenditure, we are actually getting least receipts for greatest expenditure.

The usual remedy suggested is—use more copper. Very good. But if the owners of the road are already groaning under the weight of the copper mine that has been saddled upon them, together with the cash invested therein; if they live in constant fear that they will be forced to place all feed wires in large cities underground, what then?

Leaving out of this discussion improvement in generating station, car equipment and track, we must look for higher economy to the alteration of our methods of electrical distribution, adopting such as will prove, after careful comparison, to be of least first cost, of reasonably high commercial efficiency, of interchangeability on different divisions of the system, and of practically automatic action.

We are in need of a marked advance over present practice in this direction, and must devise some method of distribution that shall give better and more economical service over a large area, and which shall at the same time enable us to reach out from the power station to distances at present inaccessible.

The alternating current system, which has done so much to develop the distribution of electricity for lighting by incandescence, has not yet reached that stage of eminent perfection in motive power service which will warrant us in admitting its value for railway work at the present time.

Another method which might be suggested is one which contemplates the use of motor generators located at intervals along the line and actuated by high tension currents. Such a system must be automatic under all conditions of load and short circuits, working with cool bearings and not requiring careful attendance. This scheme also requires practical development.

The well-known booster system, invented by Mr. W. S. Barstow, and applied by him with great success to the feeders of constant potential electric lighting plants covering large areas, is worthy of our careful investigation, as it promises to offer a practical aid to the economic solution of what may be called the medium long-distance electric railway problem.

With direct feeding we can overcome the loss in transmitting energy only by incurring the heavy cost of copper as a first investment. With the booster system we overcome the loss in transmission by incurring the cost of operation of a machine which shall automatically raise the initial voltage above that of the bus bars by an amount which may exactly equal the drop in potential on the feeder at that instant.

When using this machine we calculate our feeder for ampere capacity only, and constantly maintain the pressure at the service end of the feeder equal to the pressure at the bus bars, irrespective of the length of the feeder or the load.

In any given instance, the cost of a direct feeder increases as the square of the distance, while the cost of the booster feeder is directly proportional to the number of miles. These characteristics of the latter system result in a reduction of first cost of from 25 to 75 per cent. as compared with the first cost of the ordinary direct feeding methods of our present practice; and it thereby becomes possible for numerous electric street railway companies to extend their lines into suburban localities from ten to twenty miles distant from the power station, at the same time retaining the investment within reasonable limits.

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*Paper read at the American Street Railway Association Convention, Oct. 17-19, 1894.

In order to present these matters in a manner easily comprehensible, we can readily establish equations for the two systems to be compared; and then, by assuming certain accepted values, plot the results. Let

C_1—Current delivered to trolley wire.
V —Voltage at generator.
V_1—Voltage at trolley wire.
V_2—Voltage of booster.
Eg—Efficiency of generating apparatus.
Eb—Efficiency of booster.
E_1—Operating expenses for direct feeding—coal, oil, water, waste, engineers, firemen, and interest on so much of the steam generating and transmission plant as is due to the feeder under consideration.
E_2—Operating expenses for booster feeding—details as before.
M —Length of feeder in miles.
m —Circular mileage of feeder.
$ —Initial cost of as much of the steam generating and transmission plant as is due to the feeder under consideration.
I —Per cent. interest on investment.
D —Per cent. depreciation on investment.
s —Cost of steam plant per H. P.
g —Cost of generating plant per K. W.
b —Cost of booster per K. W. output.
k —Cost of insulated wire per lb.
p —Cost of placing 544 feet No. 0000 wire, including insulators, pins, cross-arms, sundry hardware and labor—5 per cent. allowance for sag.
z —Cost of supplying one H. P. per year, in quantities of over 100 H. P.—

Then for direct feeding

$$\$ = \frac{\frac{C_1 V_1}{746} + \frac{C_1 (V - V_1)}{746}}{Eg} S + \left\{ \frac{C_1 V_1}{1000} + \frac{C_1 (V - V_1)}{1000} \right\} g + \frac{2315.488 M^2 C}{V - V_1} + \frac{.5464 M^2 C}{V - V_1} p \qquad (I.)$$

And for booster feeding

$$\$ = \frac{\frac{C_1 V_1}{746} + \frac{C_1 (V - V_1)}{746} + \frac{\frac{C_1 V_2}{746}}{Eb}}{Eg} S + \left\{ \frac{C_1 V_1}{1000} + \frac{C_1 (V - V_1)}{1000} + \frac{\frac{C_1 V_2}{1000}}{Eb} \right\} g + \frac{C_1 V_2}{1000} b + .019318\, m\, Mk + \frac{m\, M}{211600} p \qquad (II.)$$

Substitute the following values in Equation 1:

C — 200
V — 500
V_2 — 550
S — 45
Eg — .95
g — 25
K — .13
p — 75

We have

$$\$ = 9735 + 1374 M^2 \qquad (3)$$

Substitute the same values in Eq. 2 assuming 211600 as the value of m, taking Eb—.90, and finding an expression for V_2 in terms of M, we get

$$\$ = 8732 + 2857 M \qquad (4)$$

In order to graphically represent the relation between initial investments in the two methods of feeding under discussion, Eqs. 1 and 2 have been solved for varying values of M from 1 to 30, and the results plotted on Diagram I. An inspection of this diagram shows at once the immense superiority of the booster system over direct feeding in cases where the first cost is the essential feature. It will be noted that the curves have been carried out for the entire thirty miles, without regard to the practical voltage limit in direct current machines or the point at which the cost of operating an independent station becomes less than operating from the main station.

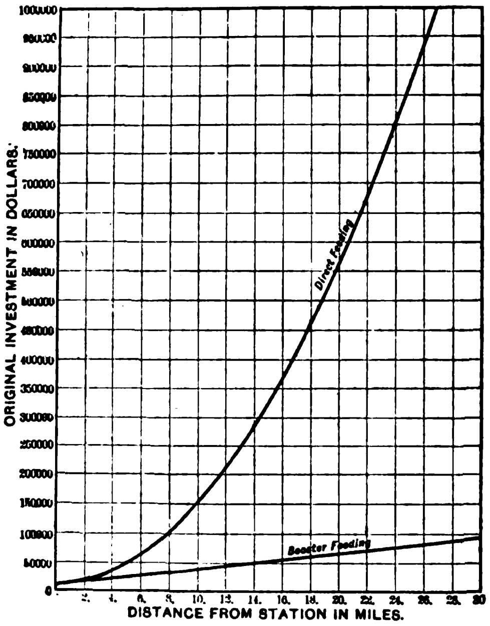

DIAGRAM I.

Initial Cost of Steam and Generating Plant, Copper and Special Apparatus for Delivering 200 Amperes at 500 Volts.

Diagram I shows that for distances greater than one and one-half miles it will cost less to install a booster system than to place copper and machinery in the usual manner for feeding direct. In cases where motive power is water, costing little or nothing per H. P., these curves give at once the relative economy of the two methods; but ordinarily, on account of the consumption of coal, the loss in the line (represented in the new method by the power required to operate the booster) becomes an important factor in the discussion; and it is necessary to establish equations for the operating expenses, taking into account the fixed charges of interest and depreciation on the investment as well as the cost of furnishing the required power.

The following equations will enable us to determine these values for different distances:

Direct feeding:

$$E' = \frac{\frac{C_1 V_1}{746} + \frac{C_1 (V - V_1)}{746}}{Eg} Z + \$ (I + D) \qquad (5)$$

$$E'' = \frac{\frac{C_1 V_1}{746} + \frac{C_1 (V - V_1)}{746} + \frac{\frac{C_1 V_2}{746}}{Eb}}{Eg} z + \$ (I + D) \qquad (6)$$

Making the same substitutions in Eqs. 5 and 6 as were made in 1 and 2, placing $(I + D) = .10$, and remembering that $ varies according to the method and distance under discussion, we get

$$E' = 155 z + \frac{\$}{10} \qquad (7)$$

$$E'' = (139 + 36 M) z + \frac{\$}{10} \qquad (8)$$

Diagram II represents these equations plotted for varying values of M, being taken at 40.

The intersection of the upper curve with the upper straight line is the point at which the booster system costs as much to operate as does the direct system. This distance we find to be twelve and one-half miles. For shorter distances, direct feeding is more economical, while for longer distances the booster system has an absolute advantage. Now, the assumption upon which Eqs. 5 and 6 were solved is a feeder constantly loaded to its maximum capacity. The absurdity of this assumption is apparent when one considers the actual conditions which obtain in railway work; the average load on the feeder during the entire year will be more nearly one-third or one-quarter of the maximum. We have therefore established and plotted equations similar to 5 and 6, for ¾, ½ and ¼ load, and the resultant curves are shown on Diagram II, in order to afford ready means of comparison.

A careful study of these diagrams demonstrates in what the economy of the booster system consists. While the method we have outlined may seem like robbing Peter to pay Paul, it must be remembered that in direct feeding there is a large amount of capital invested in the pole line, accruing interest day and night, in storm and sunshine, irrespective of the traffic on the line; while with booster feeding, the interest on copper investment is nominal, the power required to drive the booster itself being proportional to the load on the line. Thus we can readily understand why, under the conditions given, with an average load of one-quarter the maximum, the booster system is absolutely more economical than the direct feeding system for distances over four and one-half miles.

The equations here laid down will serve to answer any questions that may arise as to relative first cost or operating expense. It has been impossible to represent results derived under varying conditions without multiplying the diagrams indefinitely. All calculations have been based upon the most recent methods of rail bonding and track feeding; and the assumption that the resistance of the return circuit is equal to that of the outgoing circuit is therefore perfectly safe.

It may occur to some that the installation of a special high voltage generator to supply the feeder in question would be a simpler method of reducing the copper; but a cognizance of the enormous variations in drop under extreme changes in load, on a long feeder calculated for ampere capacity only, leads at once to the discarding of such a scheme until such time as manufacturers can furnish efficient generators over-compounded from 50 to 150 per cent.

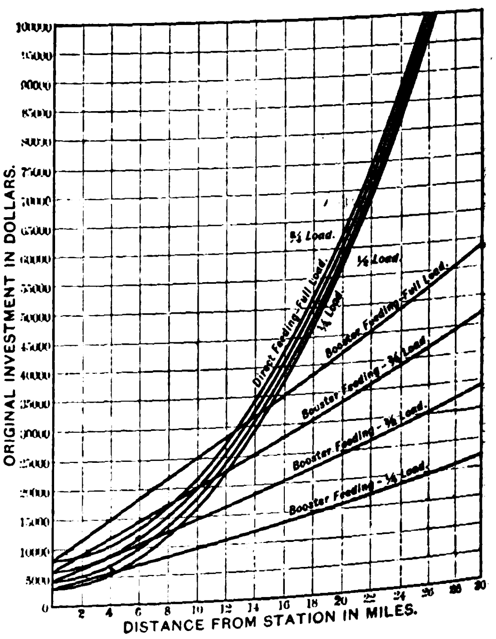

DIAGRAM II.

Operating Expenses of Plant Delivering 200 Amperes at 500 Volts, Including Coal, Oil, Waste, Water, Labor, and Interest and Depreciation on the Investment.

The adaptability of the booster to railway work of all kinds is wonderful. A few specific instances are noted, in the confident belief that the suggestions thus thrown out will impel each and every electric railway manager to personally investigate this system, with a view to ascertaining exactly how far it would prove of advantage when applied to his particular road.

Ordinarily in calculating copper for distribution, we are obliged to allow for special features influencing traffic, such as ball grounds, race tracks, picnic groves, etc. As there is seldom any necessity for bunching cars at all these points simultaneously, and as the various features are usually scattered, it follows that at all times one or more of the feeders is lying comparatively idle. Under the plan suggested, the copper is figured for average conditions, and a booster, placed in the station, is arranged to be thrown immediately upon any feeder which may become burdened with an excessive load.

Another feature of this system which makes for economy becomes prominent on long suburban lines forced to run an infrequent schedule late at night. On such a road the booster may be shut down and cut out of circuit entirely when the load on the long distance feeder drops to say one-quarter of the maximum, depending upon the amount of copper in the line.

If this suburban line extends to a park or pavilion which is open only during the summer months, the advantage of the booster over direct feeding is enormous, since the investment on a booster lying idle is a small fractional part of the interest on the idle copper of a direct feeder.

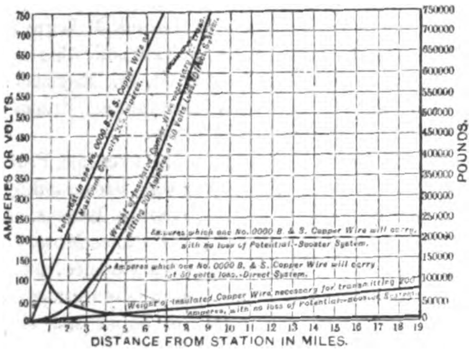

Diagram III.

Comparison between Direct and Booster Feeding for Railways. Resistance of Return Circuit (Rails=Resistance of Feeder. Allowance for Weight of Insulation=15 per cent. Allowance for Sag=5 per cent. Showing the Invest'ment Saved in Weight of Copper by Means of the Booster System.

On many roads already in operation the copper in the line has proven entirely insufficient, and the erection of additional feeders is contemplated. Would it not be worth while to consider the installation of a booster at one-tenth the cost of the extra copper, provided calculations showed the economy of operating the two systems to be equal?

In the progress of electric railways, as in the growth of cities, development frequently fails to follow the lines predicted for it. It therefore happens that many a road to day is worrying along, the victim of misplaced judgment—and copper. In many instances the adoption of a booster, and a redistribution of the present copper, will remedy the evil in the most economical manner.

In large cities such as Boston, Brooklyn and Philadelphia, the tons of copper could in this way be largely reduced, with a gain at the same time in uniformity of pressure.

An international telephone system to cover all Europe with its network is one of the latest improvements to bring the nations into more harmony and more peaceful relations with each other. The cities of Amsterdam, Rotterdam, Brussels and Antwerp are already connected by telephone and the extension of the lines is a question of only a little time.

GENERAL ELECTRIC'S METHODS.—II.

Treatment of Various Licensee Companies.

[STAFF CORRESPONDENCE OF ELECTRICITY.]

The Pennsylvania General Electric Company previous to the consolidation was known as the Thomson-Houston Electric Light Company of Philadelphia. This company was the original or parent Thomson-Houston Company, and licensed the Thomson-Houston Electric Light Company of Connecticut, whose factory was subsequently moved from New Britain to Lynn, Mass. The T.-H. Company of Philadelphia were manufacturing arc apparatus on a very limited scale. The tail in Lynn, however, soon began to wag the dog in Philadelphia, and the first example of the T.-H. "absorption" policy, which finally culminated in their own ruin and the complete demoralization of the entire electrical trade, resulted.

The T.-H. Philadelphia company having passed into the control of the Boston company, the manufacturing branch of the business in Philadelphia was discontinued, and all apparatus was bought from the Boston company. When the latter company began to extend their manufacturing business, and commenced the manufacture of incandescent dynamos, lamps, railway generators, motors and electrical supplies in general, the Philadelphia company very naturally continued to favor the Boston company with their orders. They sent in their orders, and the Boston company did the rest. Prices were of course left to the discretion of the Boston company, and there never were any disputes in regard to the amounts charged. There were no chances for dispute. An occasional bluff was made for the sake of appearances.

It might be well to remark that although the territory covered by the T.-H. Philadelphia and the Pennsylvania G. E. companies has always been one of the most, if not the most, profitable territories in the country for both lighting and railway work, *no dividend has ever been paid on the company's stock*. The cost of doing business increased proportionally with the amount done.

Since the consolidation, however, it would seem as if the G. E. Company had resorted to extreme measures. All bills rendered to the Pennsylvania G. E. Company were subject to interest charges at the rate of 8 per cent. until paid. Thousands of dollars' worth of lamps, sockets and other supplies were shipped to the Philadelphia offices, which stocked the company away beyond its needs and capacity, but it made a good showing on the G. E. Company's order books, which was all that was desired. While the district office system was in operation, the prices charged the Pennsylvania G. E. Company for apparatus were always greater than the district office cost prices to any district office.

We understand that the Pennsylvania G. E. Company is now able to show on its books a monthly loss of about $7,000.00. How long will this be continued? It will next be in order for the company to become insolvent—according to its books only, however.

Since the consolidation the G. E. Company has acquired additional holdings in the Pennsylvania G. E. Company and there are now but 170 shares of stock that they do not own. Hold on to your stock, Mr. Harkness. Hold out for your price and you will make the G. E. Company come to time. The books will soon show the company to be insolvent. Do you think they will care to air the doings of the past thirteen years in the courts? We hardly think they will. You have made a good fight against overwhelming odds, and the sympathy and moral support of the whole electrical trade are with you. A stockholder who puts up his money in good faith, and who is swindled out of all return on his investment for thirteen years through fraud and juggling in bookkeeping is in our opinion entitled to and will be given every possible consideration in our courts of justice.

The G. E. Company will hardly dare to resort to the courts, and you hold the key to the situation, Mr. Harkness, in those 170 shares of stock. The district office system was abandoned some months ago, all over the country, and all district are now selling offices. Why does the Pennsylvania G. E. Company still maintain an accounting and bookkeeping department? an engineering and construction department? a supply department and a repair and machine shop? Why does it continue the manufacture of repair parts for T.-H. arc apparatus? The question requires no answer. The G.E. Company have been threatening to close up the Philadelphia office for more than a year, and if it had not been for one resolute stockholder and 170 shares of stock they would long ago have wound up the affairs of the company, and would have reduced the Pennsylvania G. E. Company to a mere selling office. One solitary stockholder with 170 shares of stock has kept a $50,000,000 corporation at bay for two years. It seems to take a Quaker to catch a Yankee.

The Edison Electric Light Company of Philadelphia is a licensee company. Its territory covers the County of Philadelphia. Previous to the consolidation the company had been doing a very profitable business in installing isolated lighting plants. They had installed through the well known contracting firm of Walker & Kepler over one hundred isolated plants of the Edison bipolar type of machine. Their principal competitor had been the Thomson-Houston Electric Light Company. Like all licensee companies, the Edison Company were allowed a very liberal discount on all Edison apparatus and patented appliances, by the Edison General Electric Company. The exact discount was 60 per cent. off list prices. At the time of the consolidation the list prices in force for Edison dynamos were the prices shown in the price list dated June 15th, 1892. The list was a very complete one. It was printed upon cloth and is familiar to every Edison central station manager. Immediately after the consolidation, without any notification being given, the list prices on all the Edison dynamos were raised, although the discount to the licensee companies remained the same as before. This placed the Pennsylvania G. E. Company in a position where they were enabled to always underbid the local Edison Company on isolated plants with the T.-H. type D machine, as the Pennsylvania G. E. Company could not buy the T.-H. machines from the G. E. Company cheaper than the Edison Company could buy the Edison machines even with a discount of 60 per cent. The Edison Company were thus robbed of this portion of their licensee contract. It is true that the high speed belted type of bipolar machine was fast growing obsolete, and was being supplanted by the multipolar direct-connected type. This, however, does not alter the fact that the Edison bipolar machine was a better machine than the T.-H., and had a better record, and no one knew this better than the T.-H. people themselves, and the G. E. Company. The G. E. Company, however, wanted *all* there was in the business and it made no difference to them what means were used to get it. It made no difference to them whether it required the violation of contracts or the disregard of all legal and moral obligations.

Last spring the Edison Electric Light Company of Philadelphia cancelled its business contract, except that portion pertaining to the Edison lamp. Previous to doing so they ordered from the Pennsylvania G. E. Company Edison bipolar dynamos of 30,000 lights capacity for the new addition to their station. These dynamos were bought at 60 per cent. off list, the usual licensee discount. A short time ago (presumably after the delivery of the new dynamo) the Edison Company entered a claim for $90,000 against the G. E. Company for damages sustained on account of the use of infringing lamps in its territory. The total cost of the dynamos was in the neighborhood of $30,000.

In any event it does not look as if the local Edison Company would fare so very badly after all. He who laughs last generally laughs the longest. We hardly think the dynamos have been paid for as yet. Again it seems to take a Quaker to catch a Yankee.

Atlantic City, N. J.

The Electric Light Company of Atlantic City is a licensee company. Electricity has already informed its readers of the sale of incandescent alternate current dynamos to the company's local competitor by Mr. Mullen of the Pennsylvania General Electric Company. That this sale was ratified by the G. E. Company may have been due to the fact that the sales agent was a brother-in-law of Mr. Mullen, and of course it would not do to allow any commissions to go outside the family. The G. E. Company might through legal technicalities maintain their position in the above case, but what excuse can they offer for their action at Pottsville, Pa.

Pottsville, Pa.

The Edison Electric Illuminating Company of

Pottsville, Pa., is a licensee company. Its licensee territory includes the town of Pottsville and the adjoining towns of Schuylkill Haven, Port Carbon and Saint Clair. The three last-named towns are within a radius of two miles of the Edison Company's station in Pottsville, and it would be perfectly feasible and practicable to furnish light to all of them by an alternating system.

In September, 1892, the Pennsylvania G. E. Company contracted with the Borough of Saint Clair for a central station lighting plant. The contract called for the complete installation except the steam plant and buildings. The contract price was $10,627.00. The company installed two 20 K. W. bipolar Edison dynamos and one 35 light "rejuvenated" T.-H. arc dynamo. A complete Edison three wire central station system was installed, and some 350 lights were wired in stores and houses, using Edison patented sockets, cutouts and lamps.

This licensee territory was invaded, not through any ignorance, but with the full knowledge on the part of Mr. Mullen and the Pennsylvania G. E. Company that the territory was licensee territory and belonged to the Edison Pottsville company. The Pottsville company was robbed of its rights deliberately, and like murder in the first degree, it was done with malice aforethought.

The Pottsville company have entered a claim for $10,000 damages. The matter has now stood for two years without any desire being shown on the part of the G. E. Company to make a settlement.

We might here remark that even after the Pottsville company had notified the Pennsylvania G. E. Company of the invasion of their territory and entered a claim for damages the Pennsylvania G. E. Company had the audacity to still continue to sell to the Borough of Saint Clair Edison lamps, sockets and patented supplies. This is the most barefaced steal and case of highway robbery that we have as yet found in this investigation.

The Edison Company at Pottsville have had a hard time. It has been a hard fight for existence with them. They have been engaged in close competition with the local gas company who have also been operating both an incandescent and arc lighting system—Schuyler arc and Westinghouse alternating. The gas company until two years ago had the street lighting contract. It was then secured by the Edison Company, and the T.-H. Company were given the order for three 50-light arc dynamos. In return for this order, Mr. Mullen deliberately invaded the company's licensee territory and installed an Edison three wire central station and a T.-H. arc system, which will forever deprive the Pottsville company from receiving any revenue from this portion of their territory.

We wonder if Mr. Coffin had this Edison licensee company in mind when he had the brazen effrontery and impudence of a confidence man to stand before such an intelligent body of men as the Association of Edison Illuminating Companies is composed of and unshrinkingly tell them that both he and the G. E. Company were in the habit of practising the precepts of the Golden Rule.

Pottstown, Pa.

The Pottstown Electric Light Company formerly used for street lighting T.-H. 2,000 C. P. arc dynamos and lamps. The town authorities a short time ago decided to increase the number of lights, but to change the lights to 1,200 C. P. It was thought that by this means a larger area could be lighted at a proportionally less cost. The Pottstown company called upon Mr. Mullen of the Pennsylvania G. E. Company and stated the condition to him and asked what it would cost to make the change. He promptly took advantage of their ignorance and inexperience and agreed to give them 1,200 C. P. dynamos in exchange for their 2,000 C. P. machines for $5,000.

Any honest man would have explained that it would only be necessary to reduce the speed of the present dynamos to give the proper amount of current for 1,200 C. P. lights, and make proper adjustments in the lamps for the decreased current. By so doing it would be possible to return to the 2,000 C. P. basis at any time, should the company desire to do so, without any outlay.

Instead of doing so he deliberately robbed them out of $5,000. The old 2,000 C. P. lamps are now burning on the new 1,200 C. P. machines. And still the Pennsylvania G. E. Company never paid a dividend. Possibly Mr. Mullen may think that he will have another opportunity of working this same game again should the company desire to change back again at some future time. We don't think he will.

One of the "brothers-in-law" negotiated the sale and exchange, on a commission basis of course; and again we have an illustration of the desirability of keeping everything in the family.

The Pottstown Passenger Railway Company is largely composed of the same people as the electric light company, and the Ringing Rocks Electric Railway Company has among its stockholders several who are interested both in the Pottstown Passenger Railway and the electric light company. Neither of these roads has ever bought any railway apparatus from the Pennsylvania G. E. Company, although the most strenuous efforts have been made by the company's agents. Possibly Mr. Mullen may have sometimes wondered why. He need not look beyond himself for the cause. His methods are too well known in Pottstown.

Scranton, Pa.

The Scranton Illuminating, Heat and Power Company is an Edison licensee company. In September, 1892, they bought two Edison 45 K. W. dynamos and one 50 K. W. T.-H. alternator. They were compelled to pay some $250 more for the Edison machines than they had formerly paid, on account of the G. E. Company having raised the list prices on all Edison dynamos. For the alternator they were charged $2,750. A few months later we know of an instance where this same size of machine was sold for $1,950.

York, Pa.

The Edison Electric Light Company of York is a licensee company. In June, 1892, they bought two 100 K. W. Edison generators to operate the local electric railway. The Pennsylvania G. E. Company charged them $8,000 for the two machines. They would have been glad to have sold them at the time to any railroad in the country for $6,800. The railway company had invited competition and the Pennsylvania G. E. Company had been compelled to cut their price to get the order. They made it up on the electric light company. The electric light company, although a licensee, were compelled to pay a higher price than anyone else would have had to pay. The York company were informed that they were only entitled to a discount of 60 per cent. on *lighting dynamos* and not on *railway generators*. The Edison price list of June 15, 1891, gives the price of Edison dynamos, and distinctly shows that the machines may be wound for 125, 250 or 500 volts. Ordinary users were entitled to a discount of 45 per cent off list. This would bring the net cost of two machines with base frames, regulators and ammeters, to $6,854.82. The York company have a just claim against the Pennsylvania G. E. Company for extortion and they should be compelled to refund their ill-gotten gains.

Easton, Pa.

The Edison Electric Illuminating Company is a licensee company. Mr. Howard Renick is general manager. When his company wanted some railway generators Mr. Renick went to New York and bought two 100 K. W. Edison generators at 60 per cent. off list. He did not go to Philadelphia. The railroad company ordered Westinghouse motors, although Mr. Renick was one of the heaviest stockholders in the company.

Ashland, Pa.

The Edison Electric Illuminating Company of Ashland, Pa., is a licensee company. The company was organized and the plant was installed in the early eighties. The history of the company has been a continuous struggle for existence. A suicidal policy of competition with the local gas company resulted in neither company being able to make any money. The Edison company have never paid a dividend and the gas company have not paid one for several years. In addition to their gas plant the gas company have been operating a T.-H. arc system for street and store lighting.

For some time the gas company had been quietly trying to get control of the Edison company, but had not been able to secure a sufficient amount of stock to give them the controlling interest in the company. Mr. Price of the gas company called upon Mr. Mullen of the Pennsylvania G. E. Company, who agreed to secure for him the stock owned by the G. E. Company in the Edison Ashland company, with the understanding that Mr. Price would cancel the licensee contract. This Mr. Price agreed to do. He was totally ignorant of what constituted an Edison licensee contract, or what benefits there were, if any, to be derived from it. Mr. Mullen assured him, however, that it would be greatly to his benefit to cancel the contract, as he would then be permitted to buy all his supplies wherever he might desire and he could then buy where he could buy the cheapest. Mr. Mullen sold Mr. Price the stock owned by the G. E. Company for $85 a share, a fair price, we think, for a stock that had never paid a dividend in over eight years. It is more than possible that Mr. Mullen if pressed would have transferred the stock for the cancellation of the licensee contract alone. Thus the licensee contract was cancelled. Mr. Price was soon made to realize after he got back to Ashland that there were some benefits attached to a licensee contract. His first bill for lamps was the cause of some correspondence, which finally developed the fact that he could not buy a sufficient quantity of them to entitle him to the former discount of 60 per cent. Mr. Mullen had, of course through an oversight, neglected to mention this fact. The directors think that Mr. Price was swindled, and so does ELECTRICITY. Like the "green goods" victim, Mr. Price did not open his bag until he got home. He is still trying to figure out who got the worst of the bargain. Everyone else knows but Mr. Price.

American Institute of Electrical Engineers.

At the meeting of Council held at 12 West 31st street October 17, the following Associate Members were elected :

John R. Cole, Harold McGill Davis, Franz J. Dommerque, Thomas Duncan, Kingsley G. Dunn, Chas. Locke Etheridge, M. K. Eyre, James S. Ford, Arthur L. Hadley, Arthur W. Jones, Chas. L. Keller, Sherwood J. Larned, C. Per Lee Noxon, J. J. O'Connell, Camillo Olivetti, Arthur S. Rhodes. L. St. D. Roylance, Ward M. Sackett, Edwin N. Sanderson, Frederick R. Slater, Herman A. Strauss.

At the Institute meeting in the evening, Prof. Houston in the chair, a paper was presented by Lieut. Samuel Reber, of Fort Riley, Kansas, on the "Theory of Two and Three Phase Motors." The paper having been printed in advance, it was read by title by the secretary and the discussion opened by Dr. M. I. Pupin. A paper was also presented by Mr. Chas. P. Steinmetz, of Schenectady, on the "Theory of Synchronous Motors." Both papers were discussed by Messrs. Kennelly, Pupin and Steinmetz.

Seventy members and visitors were present.

It is reported that a carborundum factory is to be established at or near Niagara Falls for which the Power Company is to furnish 1,000 horse power. This new substance—carborundum—is a discovery made by E. G. Acheson after a number of experiments at Menlo Park and elsewhere. It is a grinding or polishing material, and is displacing emery, crocus and other abradents by its comparative superiority in polishing diamonds, etc. Its general composition and manufacture are thus described in the Buffalo *Courier*: "Ordinary Connellsville coke is crushed to a fine powder, and common dairy salt and a good quality of glass sand are mixed with it, in the following proportions: coke, 20 parts; sand, 25 parts; salt, 5 parts. This is placed in a furnace around a core of coke and the electric current is introduced from nine two inch rods of carbon at each end. From 150 to 1,000 amperes are used and the operation lasts from ten to fourteen hours. After cooling, the walls of the furnace are removed, the top crust broken off, and the carborundum taken out. The crystals are then crushed and thrown into a stream of water and pass through a series of tanks where they are graded. When molded into wheels the firing takes from four to six days. The product of 1893 was 15,200 pounds of carborundum. Mr. Acheson has patents in all the principal countries of the world."

The trolley car is making itself felt in our advancing civilization to such an extent that its future possibilities are bewildering even to those who have a natural talent for prediction. Here is the very latest evidence of its growing importance: "Miss Lizzie Schwab, of Bronxville, N. Y., eloped with Chas. F. Smith, her father's head farmer, Thursday evening. The couple boarded an electric car, the father chased them in a buggy, but was unable to catch them."

General News.

What is Going on in the Electrical World.

Schenectady, N. Y.—An effort is being made here to establish a branch of the National School of Electricity of which Dr. J. Allen Hornsby is secretary.

New Orleans.—The Orleans Street Railroad Company have finally decided to sell their mules and use electricity as the motive power on their street lines.

Los Angeles, Cal.—The Consolidated Electric Railway Company has applied to the city council for permission to change its horse and cable roads to electric lines.

Atlanta, Ga.—The Cotton States and International Exposition managers have closed contracts with parties who will build an intramural railway to be operated by electricity.

Savannah, Ga.—The street railway war still continues here, and the darkies are rapidly wearing out their breeches in taking advantage of a one cent fare on the competing lines.

New Rochelle, N. Y.—The board of trustees have ordered a special election by the taxable inhabitants of this village on the 25th inst., to vote on the question of levying an assessment for a bell tower and fire alarm system.

Sioux City, Iowa.—The Harrison Telephone Company has organized a company to put in an exchange here and has secured the signatures of nearly all the subscribers of the old Bell Company to its contract for five years.

Bloomfield, N. J.—The township committee has granted a franchise to the Suburban Traction Company for an electric railroad between Orange and Bloomfield, to take the place of the present road, which is operated by horse power.

Oxford, Mich.—At a special meeting here for the purpose of determining whether the village should be bonded in the sum of $25,000 for waterworks and an electric light plant, there was a large majority in favor of the proposition.

Atchison, Kan.—A party of Topeka and St. Joseph capitalists propose to build an electric railroad between this city and St. Joseph, by way of the towns of Wathena, Troy, Doniphan and Brenner, on the west side of the Missouri River.

Newark, N. J.—The plant of the Westinghouse Electric and Manufacturing Company's branch works here is being moved to the company's new mammoth establishment at Brinton, Pa. The factory here gave employment to an average of 600 hands.

Carthage, Mo.—Chicago capitalists are making arrangements for building an electric railway between Carthage and Webb City and Carterville. They have obtained a guarantee of a $15-000 bonus from Carthage and will build as soon as details are perfected.

Alton, Ill.—The two electric light companies of this city have arranged a consolidation and will hereafter be under one management. Powerful machinery will be added to the plant for the purpose of furnishing power as well as light to all who desire it.

Bay City, Mich.—Work on the electric railway that is to unite the Saginaw Valley cities will begin early in the spring. The Saginaw Electric Street Railway Company, that is pushing the enterprise, recently secured the right of way to Zilwaukee and Carrollton.

Harrisburg, Pa.—The State Department has issued a charter to the Williams Valley Street Railway Company, with a capital of $100,000, to build an electric line between Reiner City, Schuylkill County, and Lykens, a distance of twelve miles. Philip Bartner, of Girardville, is president.

Jackson, Tenn.—The horse car line here is to be transformed into an electric system. All the stock, franchises, tracks, etc., of the old company are to be transferred to a new organization whose officers are J. H. Hunter, president; G. C. Anderson, vice-president; J. W. N. Burkett, secretary; John L. Wisdom, treasurer.

Lynchburg, Va.—The city council invites proposals until Nov. 1 for the construction of an electric lighting plant—capacity 300 arc lamps, 2,000 c. p., and 2,000 16 c. p. incandescent alternating lamps, with 250 arc and 1,000 incandescent lamps installed; site, power house and foundations not to be included in the bid. Address L. P. Rodes, city engineer.

Monroe, Mich.—President Gardner, of the Toledo, Monroe and Detroit Electric Railroad, writes from Toledo that the necessary bonds have been placed and that work will be commenced this fall. The company will build lines in Monroe leading to the lake piers and will put a handsome steel bridge across the River Raisin.

Montreal, Can.—The Hon. Louis Tourville, Andrew Hardie, William B. Powell, Hy. Williams, Jos. Horsfall, Fred. Thompson and Geo. F. Burnett give notice in the Quebec *Official Gazette* that they will apply to the Legislature at its next session for an act of incorporation under the name of the South Shore Electric Company, with a capital stock of $25,000.

Hartford, Conn.—A dispatch to the *Times* from Manchester, Conn., states that "the Mather Electric Company is now running until 9 o'clock at night with a force of sixty-one hands. Even at this increased rate of production the company cannot keep up with its orders. The new type of generators and motors designed by Theo. Gonet, the superintendent, is giving great satisfaction."

Milwaukee, Wis.—At the annual meeting here of the Edison Electric Illuminating Company on the 10th the following directors were elected: Henry C. Payne, F. G. Bigelow, C. D. Wyman, H. T. Boggis, G. O. Wheatcroft, S. G. Coleman and W. L. Mason, The following officers were elected: H. C. Payne, president; F. G. Bigelow, vice-president; H. T. Boggis, treasurer; W. L Mason, secretary.

Hoboken, N .J.—A few days ago a trolley car on the North Hudson Railway Company's line in West Hoboken jumped the track and the curb and dashed across the sidewalk into a liquor saloon and well up to the bar before it stopped The motorman took in the situation instantly and stuck to his post like a man. He was uninjured but greatly amazed at his trolley exhibiting such a wonderful development of the local instinct.

Ottawa, Can.—The electric railway here, built about four years ago, and then considered a most unpromising investment, has proved a great success, having returned handsome dividends from the start. The road is a model of its kind. It was built, equipped and is controlled by the firm of Ahearn & Soper, who were the first to demonstrate the practicability of giving an uninterrupted service through the Canadian winter.

Northport, N. Y.—A company has been formed at Northport, L. I., for the purpose of building and maintaining an electric lighting plant. The capital stock of $25,000 has been subscribed. The officers for the first year are Edward Thompson, president; J. W. Fowler, vice-president; William H. Sammis, treasurer; Edward Pidgeon, secretary, and John W. Olmstead, general manager. The directors are Edward Thompson, James Cockroft, Edward Pidgeon, J. W. Fowler, J. W. Olmstead, William H. Sammis and Milton Smith.

Spokane, Wash.—The Electricians' Union of Spokane is preparing for a grand entertainment to be given probably about the end of October. The largest and most commodious hall in the city will be obtained if possible and the union will arrange during the progress of the entertainment elaborate electrical displays and effects. The electric light company has granted the free use of apparatus, wires, batteries, etc., and as there are thirty three practical and expert electricians in the Spokane union something unique may be expected.

Brooklyn, N.Y.—The Brooklyn and Brighton Beach Railroad Company is contemplating the substitution of electricity for steam upon its route to Coney Island. The success of the trolley as a means of traction upon the West End road tc Coney Island and its cheapness compared with steam are the reasons for the change. If the connection between the Brighton Beach road and the Kings County Elevated Road is made, electricity may be substituted for steam upon the latter.—The Brooklyn Electrical Society has moved into its handsome new quarters in the Edison Building. The entire expense of fitting up the rooms has been borne by the Edison Company and they have gratuitously presented them to the society for its use.

Wheeling, W. Va.—The American Electric Smelting Company of this city has completed its organization, as follows: President, Dr. John A. Campbell; vice-president and business manager, T. H. B. Haase; manager operating department, Joseph B. Hall; secretary, Robert C. Haase; treasurer, Charles Menkemeller. The directors comprise all the above. The company was formed to manufacture aluminum and other metals by electric and other processes, and for the production of articles of like nature, under United States patents owned by the company. It has secured by purchase, free from royalties of any kind, the "Joseph B. Hall's Electrolytic Process."

Somerville, N. J.—The New York and Philadelphia Traction Company have abandoned for the present their proposed plan of building a trolley road between this place and New Brunswick. After working for three months in getting signers for the right of way and securing franchises from the governing boards of Raritan, Bound Brook and this place, they ran against a snag in the Bridgewater township committee, who refused to grant a franchise unless the Traction Company would agree to macadamize the whole roadway, which is thirty feet wide, between Somerville and Bound Brook; build and keep in repair all bridges and pay a yearly license of $250. This the Traction Company would not accede to.

Philadelphia.—Surface railway construction of a novel kind has been adopted by the Delaware and Schuylkill Electric Railway Company for its line from Frankford to the Park. Ties are dispensed with altogether. Six-inch rails will be substituted for the old style nine-inch rails. The tracks will rest on concrete piers fifteen inches in depth and eighteen inches at the base. Once underground these piers, which will be set four feet apart, will be practically permanent. Laid on top of them by means of chairs belted into a strap imbedded in the concrete the six-inch rails will leave a space to be filled in at the center of the track that is just the depth of the Belgian blocks that will be used in the paving. From this it can be seen that when the rails wear out they can be taken up without tearing up the street. The plan has already been approved by the Survey Bureau.—At the annual meeting of the Electric Traction Company on the 16th inst., the old board of directors were re-elected. They in turn re-elected the old officers of the company.

St. Louis.—The street railway system of St. Louis is extending rapidly, and in a short time every district in the city will be within easy reach of some line of electric or cable cars.—The *Globe-Democrat* publishes the following statement of a "prominent member of the electrical fraternity": "Within ninety days at the furthest a new-fangled electrical apparatus will be introduced here by the Edison Illuminating Company, the city contractors for furnishing the street lighting. Preparations at the power house at Nineteenth and Gratiot streets are about completed for the reception of one of the huge monsters, an alternator that will require a 2,000-horse-power direct connected engine to run, as its capacity will be from 16,000 to 18,000 16-candle-power lamps. The designers and constructors of this machine, the General Electric Company of New York, have termed that style of furnishing energy the monocyclic system, which means that the output is a single phase alternating current, which can be made with the aid of secondary appliances to furnish electricity that can be used for any purpose."

Boston, Mass.—The West End Street Railway has just added to its stock two new cars which are probably the handsomest and costliest street cars ever made. The cars are painted a rich wine and dark bottle-green outside, with elaborate decorative work in gold. The top lights are of stained glass, the colors harmonizing with the tints in the car body. The interiors are in solid cherry, with silver metal work. The seats are folding opera chairs, upholstered in blue velvet, with ten on a side. There are six large plate glass windows on each side, with rolling shades and inside draperies, the latter of heavy silk. The cars are lighted by eight incandescent lamps with delicately tinted shades, while there are two railway lamps at the ends of the cars to be held in reserve. The floors are carpeted. Brass projections on the corner of the body of each car enable the conductor to reach the roof in case of an emergency. A special feature of these cars is the red light which is always to be shown at night just under the roof at the rear. The cars are to be used only for parties.

Tonawanda, N. Y.—It is reported that a purchase of fifty acres of land here was made by representatives of the American Structural Company for the purpose of building a $1,000,000 iron plant to be operated with electricity by a new process devised by E. M. Butz, a Pittsburg engineer. The plant is to employ 2,500 men and receive its power from the Cataract Power Company of Niagara Falls. Mr. Butz is reported as saying that the company will make metal beams and structural shapes at the cost of billets, and will be able to manufacture built-up columns at one-half their present cost. The process consists in working the four sides of a beam simultaneously and direct from the billet into the finished article. This is accomplished by a train of eight sets of rolls, each set adding its quota to the bloom or billet as it passes through. The material enters at the rough end a bloom or billet and comes out after eight passes through the rolls ready for shipment. This method can be applied to beams of any size. Channels and angles can be made by a process as rapid and in such shapes as will lessen the labor on built up work. Where a column is built up of angles and a plate riveted together now, the new mill will furnish a solid shape that will dispense with riveting altogether. Round columns that now require four shapes riveted together to make them, can in the future be made by joining two.

The Central Electric Company.

The Central Electric Company, after having made exhaustive and careful tests of the B. & S. compounds and paints, will handle this product in the West as general Western agents. They report that they find that the B. & S. products are the highest insulating mediums of their kind on the market; and state that they will carry a large stock in their Chicago warehouse, and have already secured sufficient orders to prove that the trade appreciates the superiority of this product.

The Packard Electric Company's Transformers.

Users of alternating current should not fail to apply to the Packard Electric Company of Warren, Ohio, for a copy of a descriptive pamphlet recently published, entitled "The Packard Transformer," in which they will find a great deal said about transformers and other electrical matters that cannot fail to interest and probably be of profit to them. Besides the Introduction, in which reasons are given for the claims of superiority made for the Packard Transformer, there are chapters on Regulation and Efficiency of Transformers, Insulation, and Fusing Devices. There are also a number of illustrations showing the different sizes of transformers and their appendages.

An Enterprising Concern.

The Siemens & Halske Electric Company's factory was destroyed by the great lumber fire in Chicago, August 1. The company made a lease with the Grant Locomotive Works August 11; they commenced moving into the new works August 15; they finished and shipped the first generator, built entirely at the new factory, October 15. Every available tool in the new works is now in operation, and many of the tools which were destroyed in the fire have been duplicated, so that from now on the company is in position to finish one direct coupled generator each day.

These few simple facts indicate the dauntless spirit of the company, and they are certainly to-day in a better condition for competition in the electrical field than before the fire.

A Book for Lamp Buyers.

A little pamphlet recently published by the New York and Ohio Company of Warren, Ohio, is handsomely ornamented and illustrated with a number of engravings of the various styles of Packard Lamps manufactured by the company and of several other articles of their make. Full descriptions and other information respecting the lamps accompany the illustrations, and there is a diagram showing the curves plotted from the results obtained by the World's Fair Commission in its test of Packard Lamps. An ingenious telegraph code is also given for the convenience of customers.

The Packard Lamps are so well known all over the country that it is unnecessary to say anything in their favor—they speak for themselves, literally in glowing terms. The lamps shown in the pamphlet are, beginning with "Our Baby," of 5 and 6 c. p., the "Regular Low Voltage Lamp," 8 to 20 c. p.; "Regular High Voltage Lamp," 8 to 20 c. p.; "Series Burning, Supported Filament Lamp," 16 c. p.; "Theater Lamp," 32 c. p.; "Regular High Candle Power Lamp," 25 to 50 c. p.; "Packard Mogul Lamp," 200, 300 and 500 c. p., 2½ to 3 watts per c. p. efficiency, and "Packard Stereopticon Lamp."

The pendants, street fixtures and focussing outfits manufactured by the company and shown in the pamphlet, are of handsome design and finish and seem well calculated for effective service.

Mr. J. W. Packard, one of the members of the New York and Ohio Company, is the inventor of the Packard Vacuum Pump, universally used in the manufacture of incandescent lamps.

INCORPORATIONS.

The Abbeville Light, Water and Power Company, Abbeville, S. C.—to establish an electric light and power plant and waterworks. Capital stock, $30.000. Incorporators: J. S. Cochran, P. Rosenberg, W. C. McGowan, G. A. Visanska, J. Allen Smith and J. C. Klugh.

The Ironton Street Railroad, Light and Power Company, Ironton, Ohio—to operate a street railroad and furnish light and power. Capital stock, $100,000. Promoters: H. A. Marting, Leo Ebert, R. Mather.

The Peekskill and Cortlandt Electric Railway Company, Peekskill, N. Y.—to build and operate a road four miles long in the towns of Cortlandt and Yorktown and village of Peekskill. Capital stock, $150,000. Promoters: Edgar Peckham, Benj. Norton, of New York City; H. C. Soap, of Kingston, N. Y.

The New Athens Electric Light and Power Company New Athens, Ill.—to furnish the village of New Athens and its inhabitants with electric light, heat and power. Capital stock, $4,500. Promoters: Isfried Probst, Paul Lehman, Frank Fenerbacher.

The Citizens' Street Railway Company of Battle Creek, Mich.—to own, construct and operate a street railway, and furnish electric light and power. Capital stock, $100.000. Promoters: Loren N. Downs, New York City; Hale P. Kauffer, T. N. Rowley, Kalamazoo, Mich.

The Mattawa Electric Light and Power Company, Mattawa, Can. Capital stock, $10,000. Incorporators: C. Rankin, Dr. C. W. Haentschel, R. Shanks, A. F. Hurdman, Alex. Ross, L. H. Timmins and R. G. Plaw, all of Mattawa.

The Capital Electric Company, Springfield, Ill. Capital stock, $60,000. Incorporators: John McCreery, Peter W. Harts, Fred D. Buck, George Pasfield and Edwin A. Wilson.

The Carbonized Stone Company of Chicago, Chicago, Ill.—to manufacture artificial stone; deal in natural stone; construct electrical conduits, railroad beds, floors, etc. Capital stock, $250,000. Promoters: Geo. Richardson, W. L. Springer, Jos. Schumacher, Jno. Weis, M. O. Williams, Herman Zapel.

The Kansas City Traction Company, Kansas City, Kan.—to acquire, construct and maintain a street railroad. Capital stock, $1,000 000. Promoters: B. S. Coler, Brooklyn, N. Y.; Wm. J. Smith, Wm. H. Lucas, Kansas City, Mo.

The Sinaloa Electric Light and Power Company, Des Moines, Ia.—to establish an electric light and power plant in the city of Gulican, State of Sinaloa, Mexico. Capital stock, $20,000. Promoters: Warren A. Drake, Clarence S. Brown, Chicago, Ill.; Carlos E. S. Covar, Sinaloa, Mex.; C. E. Hunn, Des Moines.

Auto-Electric Company, Grand Rapids, Mich.—to manufacture and sell electrical apparatus from letters patent. Capital stock, $15.000. Promoters: Fred. C. Norris, Lansing, Mich.; W. F. Sweet, W. S. Burnett, Grand Rapids.

The Grafton Electric Company, Grafton, Mass.—to generate, sell and distribute electricity for light, heat and power. Capital stock, $10,000. Promoters: Clarence R. Pratt, Clarence McClelland, Geo. W. Fisher, Chas. L. Pratt, Chas. H. Miles.

The Whittingham Electric Car Heating Company (incorporated in W. Va.) Baltimore, Md.—to manufacture, sell, etc., heating or other apparatus and generally for the purpose of dealing in such. Capital stock, $100,000. Promoters: P. H. McLaran, Alex. Brown, Henry Williams, Baltimore.

The Cape Girardeau Water Works and Electric Light Company, Cape Girardeau, Mo.—to operate a water and light plant. Capital stock, $100,000. Promoters: Leon J. Albert, David A. Glenn, Richard E. Gannon, of Cape Girardeau.

The Bethlehem and Nazareth Electric Street Railway Company, Bethlehem, Pa.—to construct, maintain and operate an electric street railway. Capital stock, $100,000. Promoters: Ashton C. Borhek, Albert Brodhead, Abraham Schropp, Bethlehem.

The Dauphin Light, Heat and Power Company, Harrisburg, Pa.—to supply light, heat and power, or any of them by electricity, to the public in Harrisburg, Pa. Capital stock, $50,000. Promoters: Jos. Pyne, Mercer R. Tate, J. Grant Koons, Harrisburg.

The Dundee Electric Light Company, Dundee, Mich.—to produce, generate and sell electricity and electric light. Capital stock, $12 000. Promoters: Cora Watkins, Ida Avis, Geo. T. Avis, D. H. Chapman, of Hudson, Mich.

The Electric Messenger Company, Pittsburg, Pa.—to operate telegraph and telephone lines in Adams, Allegheny, Armstrong, Beaver, Bedford, Bucks, Berks, Butler Blair, Cambria, Crawford, Center, Cumberland, Chester, Clearfield, Clarion, Delaware, Dauphin, Erie, Fayette, Franklin, Greene, Huntingdon, Indiana, Juniata, Lancaster, Lebanon, Montgomery, Mifflin, Mercer, Philadelphia, Perry, Schuylkill, Venango, Washington, Westmoreland and York counties, Pennsylvania, and in and through the States of New Jersey, New York, Ohio, Indiana, Illinois and West Virginia. Capital stock, $25,000.

The Marion Electric Light and Power Company of Marion, Ohio, has increased its capital stock from $40,000 to $100,000.

The Summit Improvement Company, Summit, N. J.—to manufacture, store and furnish electricity. Capital stock, $30,000. Promoters: Wm. Halls, Jr., Chas. E. Kimball, Theo. F. White, Summit.

The Eastern Tramway Construction Company, Jersey City, N. J.—to construct and equip electric street railways. Capital stock, $2,000. Promoters: Edward Ellis, Ridgewood, N. J.; John E. Rowles, Geo. H. Wright, New York City.

The Westlake Electrical Manufacturing Company, East St. Louis, Ill.—to own and control patents to manufacture electrical appliances, and general manufacturing business. Capital stock, $100,000. Promoters: Chas. T. Westlake, David Biggs, Edw. Sells, Chas. Cummings Collins.

The Imperial Electric Bell and Fire Alarm Manufacturing Company, Huntington, W. Va.—to manufacture W. J. Schweiger's patent electric bell and fire alarm, all appliances, etc. Promoters: Jas. K. Oney, E. B. Enslow, C. E. Gwinn, Huntington.

The Lake Shore Electric Railway Company, Chicago—to build and operate an electric railway connecting Chicago and Milwaukee. Capital stock, $10,000,000. Incorporators: John L. Cochran, Clarence Buckingham, Dunlap Smith, D. H. Louderback and Frank P. Hawkins.

The Long Island Electric Railroad Company has certified to the Secretary of State at Albany an extension of its routes in the village of Jamaica and in Jamaica and Hempstead townships, to include the villages of Queens, Hollis and Hempstead and Hewletts, Woodbury, Lawrence, Far Rockaway Beach, East Rockaway and Long Beach.

The capital stock of the Delaware County and Philadelphia Electric Railway Company has been increased from $120,000 to $500,000, in order to provide funds for the extension of the line to Media.

The East Liverpool Telephone Electric Company, East Liverpool, Ohio—to construct and operate a telephone system and furnish electric light, heat and power, etc. Capital stock, $10.000. Promoters: Jas. C. Diedrick, T. A. Corcoran, G. W. Meredith.

The Akron, Bedford and Cleveland Railroad Company, Akron, Ohio—to construct and operate an electric railroad and generate electricity for light, heat and power, etc. Capital stock, $300,000. Promoters: John F. Sieberling, F. A. Sieberling, Jas. Christy, Jr.

The Wayne Electrical Light and Steam Heat Company, Wayne, Pa. Capital, $1,000. Among the incorporators are James W. Paul, Jr., Walter B. Smith and Herman Dercum, of Philadelphia.

The Commonwealth Electric Construction Company filed articles of incorporation in the clerk's office at Camden, N. J., on the 12th inst. Capital stock, $100,000.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED OCTOBER 16, 1894.

ELECTRIC RAILROADS AND APPLIANCES.

527,546. Trolley. William H. Bache, Bound Brook, N. J. Filed Oct. 31, 1893

527,601. Conduit Electric Railway. Oliver B. Finn, Philadelphia, Pa. Filed March 16, 1894.

ELECTRIC LIGHTS AND APPLIANCES.

527,559. Electric Arc Lamp. Alfred H. Moses, Jr., St. Louis, Mo., assignor of one-half to Jules S. Bache & Co., New York, N. Y. Filed Jan. 21, 1893.

527,608. Light-Indicator. Louis F. Johnson, Poughkeepsie, N. Y. Filed April 7, 1894.

527,623. Shade-Holder for Incandescent Lamps. Edgar A. Russell and Nathan W. Crandall, Wallingford, Conn., assignors to the Housatonic Manufacturing Company, same place. Filed May 31, 1894.

MOTORS, DYNAMOS, ETC.

527,415. Dynamo-Electric Machine. Ezra Fawcett, Alliance, assignor of one-half to Leonard W. Bradley, Cleveland, Ohio. Filed Feb. 15, 1894.

TELEPHONE AND TELEGRAPH APPARATUS.

527,518. Secret Telegraphy. Alfred D. P. Weaver, Jackson, Miss. Filed Dec. 26, 1893.

527,759. Telephone-Call Register. William T. Gentry, Atlanta, Ga. Filed April 20, 1894.

BATTERIES.

527,436. Primary Battery and Portable Electric Lamp. Samuel W. Maquay, London, England. Filed Jan. 4 1894.

SIGNALS AND SIGNALING APPARATUS.

527,461. Apparatus for Signaling the Approach of Street-Cars. Garland B. St. John, Kalamazoo, Mich., assignor of one-half to Charles D. Fuller, same place. Filed Nov. 27, 1893.

527,481. Treadle for Use in Railway Signaling. John G. Dixon, Birkby, England. Filed Feb. 20, 1894.

MISCELLANEOUS.

527,414. Electric Cable. Thomas J. Dewees, Palmyra, N. J., assignor to the Electric Cable Construction and Maintenance Company of Pennsylvania. Filed June 20, 1894.

527,439. Non-Conducting Material and Method of Forming Same. Henry C. Michell, Toronto, Canada. Filed April 24, 1894.

527,501. Multiple Safety Cut-Out. James F. McLaughlin, Philadelphia, Pa. Filed Jan. 18, 1890.

527,528. Electric Clock. Carl Gullberg, Jersey City, N. J. Filed Sept. 16, 1893.

527,586. Weather Protecting Covering for Electrical Conductors. Edwin J. Houston, Philadelphia, Pa. Filed Nov. 17, 1891.

527,730. Rheostat. Alton J. Shaw, Muskegon, Mich. Filed March 15, 1894.

ELECTRICITY.

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EDITORIAL NOTES.

Is It a Blind Pool?

An officer of the G. E. Company, presumably one who makes his headquarters at Schenectady, is quoted as follows:

> The General Electric Company's officers, in view of recent attacks on the stock, have stated that the nature of the company's business is such that it is not practicable to give the stockholders official information as to what the company is doing oftener than once a year.

If the word "directors'" were substituted for "company's" in the above it would be a frank statement. The nature of some of the directors' business is such that if the stockholders knew it all indictments by grand juries would follow very soon.

However, the stockholder who will submit to the treatment suggested above deserves no better fate than to be robbed of every dollar invested.

Evidently the days of blind pools and blank fools are not over.

We supposed this company was now, as claimed, doing business something after the style of legitimate manufacturing companies.

The nature of the company's business is such that it is not practicable to give the stockholders official information as to what the company is doing oftener than once a year!

What is the nature of the company's business? Are they losing money so fast that they are afraid to show what they are doing? Are they afraid of the penitentiary if they make another untrue official statement? Is the actual deficit at the present time equal to the entire issue of common stock, or is the treasury chest groaning with a tremendous surplus?

The nature of the company's business has been such from the beginning that it is a stench in the nostrils of the community, a disgrace to the dummy directors who have allowed their names to be dragged in the mire, a scandal besmirching the entire range of electrical investments in this country, a reproach to every one who has had any share in the company's management.

Who will be the first honest director to tell what he knows?

* * *

Now WE know what Mr. Paul T. Brady has been doing in Syracuse.

Their Future is Behind Them.

At the recent annual convention of the American Gas Light Association in Washington many bright and shining lights of the gas-making brotherhood were present, and our esteemed contemporary, the *American Gas Light Journal*, sent its jolliest scribe down from New York to report the proceedings, but despite the influence of dry wine and terrapin stew the spirits of the convention ranged between freezing and very frigid. Mr. W. H. Pearson, the learned President of the Association, did his level best to screw the courage of the gas folks up to a sticking point, but it was evident that the fear and trembling inspired by the knockout blows dealt by the young giant electricity to the light of our granddaddies froze the genial currents of the souls of the gas men, who mourn the days of auld lang syne when they used to charge $3 a thousand cubic feet for every eight hundred feet delivered. President Pearson said in his address: "Ten years ago we met in the beautiful city of Washington. Since then the electric light has made most marvelous strides, and so rapid has been its progress that at one time fears were entertained that gas as an illuminant would to a large extent be superseded, but happily, so far from such fears having been realized, gas lighting, from a combination of circumstances and largely from a demand for more light, caused by the introduction of the arc light (Mr. Pearson evidently does not reason according to Whately), has during the past decade increased at probably a greater ratio than during any decade since its introduction, while the consumption of gas for fuel purposes has gone up by leaps and bounds." Then he goes on to bewail the fact that people prefer electric motors to gas engines, and he asks the makers of gas engines to reduce their prices, as the cost of a good electric motor is only one-third or one-half the price of a gas engine.

He notes the fact that the consumption of gas in Massachusetts has increased 2½ per cent. in a year, and makes the astonishing statement that the State has not increased its population within the same period, a statement that is evidently an error. He then goes into the price of gas in

1882, when it averaged $2.41 a thousand, and shows that the average to-day is $1.38 a thousand cubic feet, which fall in prices means an annual loss of $37,510,530 in the output of ninety gas works which cut rates to meet electrical competition. He hints that many gas companies have come to the end of their ropes as far as cutting prices are concerned, because of bonded debts and capital altogether out of proportion to the value of the plants. His last wail in the caverns of gloom is a passionate protest against municipal ownership of gas plants, and he sees in this an ogre that will rob the poor gas stock owner of his chance to grow fat clipping 10 and 12 per cent. coupons from bonds. We are glad that we did not attend the convention, which was mournful and dispiriting.

During the second day two farmers from Maryland were asphyxiated by illuminating gas in a Washington lodging house, which accident produced such a hubbub in the convention that the men appointed to read papers about "The Deadly Electric Wires" and "Gas the Safest Light" were side-tracked for the next session.

Within a few years our most civilized cities will pass ordinances prohibiting the use of gas in sleeping apartments, and in the next decade mankind will wonder that people ever permitted a deadly and insidious poison to be conveyed into the chambers of loved ones. Gas has a horrible death roll to answer for—more than 250,000 persons have been asphyxiated by it since 1826. It is said that the American Society of Architects will be appealed to shortly to take action upon the prohibition of gas in chambers.

* * *

Patent Breaking. The breaking of nonsensical patents proceeds in Pennsylvania. By the decision of the U. S. Circuit Court of Appeals at Philadelphia last week, in the case of Maitland vs. Gibson, it is finally settled that there are no valid fundamental patents on combination gas and electric fixtures. It was mistaken belief in these patents which brought about the ill-starred combination in the fixture trade a few years ago. This fixture trust succeeded for a time in extorting royalty from nearly every manufacturer in the country. The combination, however, went to pieces, as did nearly every one of the individual concerns who composed it. The Horn-Brannen Company of Philadelphia were the only large manufacturers who stood out from first to last against any combination, or the payment of any blackmail, and the result is that they are in the best condition of any concern in the business to-day. We suppose Mr. James Brannen is now feeling very well because of the stand he took. Trade combinations of this nature are a fallacy, and a few years more will see the last of them.

* * *

How can the G. E. Company be making money? A sample sale of last week was two 50-light arc machines at $1,500, with an allowance of $350 for an old 35-lighter, making $1,150 net for the two new machines. This was in a New England town. If good apparatus can be bought at these figures, everybody ought to know it.

The Art is Not Lost. Users of incandescent lamps are well aware that there has been during the past year a marked improvement in the quality of the lamps made at the Harrison factory of the G. E. Company, due to a better filament.

About a year ago a young man came back from Paris, bringing with him a slight knowledge of a filament process which was being used in one of the leading factories there with good results. He sold his idea to the Harrison people, and they turned it over to their chemist to work out. After several months' experimental work, he succeeded in making the best filament ever turned out at that factory.

A few weeks ago he left the employ of the company voluntarily, and took his knowledge with him, leaving no successor who understood the process. And now for three weeks the entire technical force of the Harrison factory have been struggling with the problem, but with no success. Not one good lamp has been made there in the three weeks. The stock is low, and last week Mr. Upton prepared a draft of a circular letter to customers stating that until further notice no orders would be accepted. The committee on sales would not allow it to be sent out, however, and orders are being piled up without any prospect of their being filled this season with good lamps.

They have now returned to the old bamboo filament, and the former poor quality of lamps may be expected.

The art is not lost, however, and we suppose the man who has it will turn up somewhere.

* * *

The desire *on the part of Messrs. C. A. Coffin, Eugene Griffin, E. W. Rice, Jr., O. T. Crosby and S. D. Greene to recover the money they have lost in General Electric is natural, and should not be criticised. But that they should, as reported, offer their influence, for a consideration, to a New Jersey land syndicate which is trying to make a trade with the General Electric Company involving some of the company's factories, while perhaps natural, would not be beyond criticism.*

* * *

There is a young man in this town named Moore, who, in common with his company, seems to think that press notices are preferable to actual achievement in the race for fame. They forget that Edison's industry in the press notice business would have made him ridiculous if he had not also been a man of accomplishments. This is a sample from one of the notices which are being given out, with photographs:

> New York is probably the only place in the country where young men can grow famous easily. D. McFarlan Moore is one of the latest youths to make a hit. He is now the rival of another famous young fellow in the same field of endeavor, Nikola Tesla. Moore is a trifle younger than Tesla, and the two are at present running a race in the matter of electrical discovery. Both are working along the same lines and their rivalry is attracting great attention.

If there is any rivalry between Moore and Tesla, the former is the only man in the world who knows it. Mr. Moore's photograph shows him to be quite young, and his methods confirm that view. He would better wait until he has *done something*. Then we will all write him up voluntarily, and he will save stationery and typewriters' bills.

* * *

We note that several well-known gentlemen in the West have been indicted for violating the Interstate Commerce law. If the Commissioners want to find some smaller fry, we can help them. C. A. Coffin would do for one, and also B. E. Sunny. We fear, moreover, that the rebates they got went no further than their own pockets, and were not turned over to their company at all. The addresses of these gentlemen, Messrs. Commissioners, are 44 Broad street, New York, and Monadnock Building, Chicago, respectively.

* * *

Readers of our Boston Notes this week will learn that an early receivership is looked for for Northwest G. E. There is always genuine news in our Boston column.

* * *

No one who is hustling for business can afford to miss our "General News" department any week. It is full of pointers every issue.

* * *

We note that Alden & Faxon, advertising agents, of Cincinnati, are sending out a small line of advertising to trade papers. We warn our contemporaries that they are deadbeats and swindlers, and that no reputable journal can afford to take their business even if paid for in advance.

* * *

Some short time ago at a meeting of financiers in New York the question was put to Mr. H. McK. Twombly: "How is it, now that Mr. C. A. Coffin is so bitterly opposed by his fellow-directors of the G. E. Company, and is subjected to so many indignities at their hands, that he does not resign his position as president?" And the answer was: "Because Mr. Coffin is sitting on an unsound egg and is afraid to move because of the malodorous effluvium that would certainly arise." We guess Mr. Twombly knows.

* * *

The Boston *Herald* financial man says in regard to G. E. reorganization:

> There is some inclination to cut down the capital, but the cumulative preferred dividend contract is bothersome. It has been suggested that a new preferred stock, preferred as to principal and dividend, but non-cumulative, be given to bear a lower interest rate than the present 7 per cent. stock, which is preferred as to interest only. Why not exchange both stocks for a new common stock at a fair relative valuation, making the issue not more than half the present combined issues. The need of conservatism in capitalization is very great. Concerns that meet that need will apprehend their foresight.

Mr. Hosmer talks common sense, but his advice will not be taken. The swindle is not yet completed.

New Lighting Company for Syracuse.

By referring to the files of Electricity for 1892 full information can be secured as to the G. E. lighting combination in that town.

The city contract expires in April next. Last week there was incorporated there the Citizens' Electric Light Company, who expect to be in shape to compete for the new contract. They will use Westinghouse apparatus. The incorporators of the new company are Wilber S. Peck, Judge Silas B. Hahn, William K. Pierce and Paul T. Brady, of Syracuse, and others of Rochester and New York.

THE TRIP TO ATLANTA.

B. E. G.

How dear to our hearts is the trip to Atlanta
When fond recollection engages the mind;
It would take up the space of a Byronic canto
To tell of the place and its people so kind.
The grounds decked with flowers, though late in October.
The air so ozonic one would feign gulp it down—
(Inhaling such air it is hard to keep sober,
So at least we were told by the men of the town).
The men of Atlanta, the men of Atlanta,
Who opened their hearts and who gave us the town.

We'd read of these people, their greatness, their glory,
Had heard of their kindness, their courtesy rare,
And Grady had told us (who ne'er told a story)
That nowhere on earth were the women so fair.
But now we can speak from our own observation:
When we are about they will ne'er be turned down;
Their praises we'll sing without reservation,
For what charmed us most was the folks in the town.
The folks of Atlanta, the folks of Atlanta,
Who told us so often that we owned the town.

The Georgian julep,—where can it be equalled,
As mixed for the guests at the Kimball House bar?
Who'd fail to remember the sweet singing darkies,
Still hunting the 'possum as in days fo' de war?
Now old Uncle Remus is nearer and dearer,
We'll read him more often when feeling cast down,
For we've found out his secret, and naught could be clearer—
He got all his stories from coons in the town.
The coons of Atlanta, the coons of Atlanta,
Who tell Uncle Remus the news of the town.

The talk of the railway *savants*, though enticing
To those who were thinking of roads and of rails,
Of conduits and motors, of wiring and splicing,
Of passenger traffic, freight, express and mails,
Was irksome at times, and we welcomed the day on
The programme for eating the oxen set down,
When the pilgrims all journeyed to Ponce de Leon—
And the barbecue heightened our love for the town.
Bright Ponce de Leon, Bright Ponce de Leon,
Where cattle were roasted for guests of the town.

We'll dream of the cotton fields white, and the darkies,
The mansions with porches as wide as the lot,
Suggestive of lordly repose and contentment,
Where troubles and trials must all be forgot.
No wonder thy praises are oft sung in measure,
Atlanta, deserving of all thy renown!
And wherever we go it will e'er be our pleasure
To shout for the people who live in the town.
The folks of Atlanta, the folks of Atlanta,
Who made no reserve when they gave us the town.

New York Electrical Society.

At the meeting of the New York Electrical Society at Columbia College on Thursday evening, November 1, Mr. Joseph Sachs will answer the question, "Is There a Solution of the Electric Conduit Railway Problem?"

Cleveland Wins.

The action of the Executive Committee of the National Electric Light Association at a meeting held at New York, September 11, in selecting Cleveland as the place for holding the next Convention, has been confirmed. It is now definitely settled that Cleveland, Ohio, is the place, and February 19 20-21, 1895, the date.

Trouble 3,000 Miles From Home.

G. E. Plants Fail in California.

In commenting upon the failure of the G. E. plant at the Banner mine in California, the *Pacific Lumberman* says:

> Last November the Electrical Engineering Company secured a contract for a power transmission plant for the Mammoth mine at Madera. It consisted of a 125 horse power generator, one 30, one 20, three 10, and some 6-horse-power motors to operate mill, hoisting works, pumps, etc. Transmission, 8,500 feet. The machinery was built in this city and the plant put in operation without a hitch within the specified time. There has not been the slightest trouble with this plant since it started up.
>
> Last December the General Electric Company secured a contract for a power transmission plant for the Banner mine, near Oroville. It consisted of two 80 horse power generators, one 70 horse power motor, two 35 horse power motors and one 10 horse power motor, to operate mill, hoisting works, etc. Transmission 10,000 feet.
>
> When the plant was started up it would not work and several weeks were spent in experimenting.
>
> We call especial attention to these two plants because we wish mining men to note that the trouble at the Banner mine is not due to the fact that electric power transmission is not a success. Where good machinery is used, and competent engineers are employed, there need be no guesswork about power transmission plants. This is shown by the work of the Westinghouse Company and of the Electrical Engineering Company.
>
> Doctor Addison, the General Electric Company's agent, has been East to try and fix up the bonding proposition of the Folsom and Sacramento transmission scheme. It is said that he is also anxious to repair his fences in the East, which are somewhat dismantled owing to the trouble at the Banner mine.
>
> Mr. Eckart, the well-known engineer, has, since our last report, made an inspection of the General Electric Company's plant there, and what he found was calculated to make a mechanical engineer weep. The plant looked as if it had been put up at a guess to see what would happen.
>
> It looks as if the Doctor was not going to have such a walkover in power transmission plants as he had in electric roads.
>
> "He is on the wrong side of the fence this time,
> There's a heap of trouble on the old man's mind."
>
> Inquiry among the electrical men shows that in the next twelve months an immense amount of power transmission work is to be done on this coast. And we are glad to notice that the raw work done by the General Electric Company at the Banner mine is not hurting power transmission so far as the other companies are concerned.

We are glad that our contemporary has the courage to tell the truth. The fact is the G. E. Company has never put in a successful mining plant, and has never been paid for one without legal complications. The most inglorious failure in the whole career of the company has been in its mining department.

This department is in charge of Mr. J. R. McKee, a man without any qualifications whatever for his position, who knows nothing of mining, nor of men, nor of mechanics—a man so ignorant that he would fail in the entrance examination of an ordinary grammar school. His chief assistant is a man named Booth, who ought to be well known in 'Frisco, where he was a draughtsman at $2.50 a day whenever he was able to work at all. His pull with McKee is something of a mystery, while the latter's pull on the G. E. Company is easily explained—he was hired upon the assumption that he could help the Coffins into society. Of such stuff is this remarkable business organization made up.

Of course power transmission is all right, but every failure of the G. E. Company is an injury to the business, and ELECTRICITY will never cease until the company is reorganized and rejuvenated.

To Organize a State Association.

Full of enthusiasm after the recent convention in Atlanta, the leading street railway men of Georgia have inaugurated a movement for the formation of a State Association. The leading spirits are Messrs. Joel Hurt, president of the American Street Railway Association and also president of the Atlanta Consolidated Street Railway system; Major D. B. Dyer, of Augusta, who is at the head of that city's street car service; Mr. Sedden, of the Atlanta Traction Company; Mr. Young, of Savannah, and Mr. Jack King, of Rome.

TROUBLE AT SCHENECTADY.

A Free-for-all Fight in Progress There.

(Special to ELECTRICITY.)

SCHENECTADY, Oct. 29.—The days of Darling are numbered. His head is in danger. The basket and sawdust are ready and the guillotine knife has been sharpened for use.

Mr. J. P. Ord, the whilom popular favorite at the Matrons' Club in this town, has fallen from grace—not with the members of said club, oh dear, no! but with the directors of his bankrupt aggregation—and is shaking in his shoes. Capt. Eugene Griffin, true to his military instincts and training, is at sword's points with Ord. S. Dana Greene's scalp is being sought for daily by at least half a dozen men whose heads are not empty, as his is, of everything save conceit and bombast.

Predictions favor the belief that very shortly something heavy will fall in the charmed circle whose names have been mentioned.

One by one they are in a fair way for sinking into the infinite azure of the past, when they will be nothing more than historic reminiscences.

MOHAWK.

They Guy Their Aldermen.

If the Aldermen Know Less Than the Editor, Heaven Help the City.

(From the Detroit Journal.)

How quickly the strength and force of men expand to meet great exigencies! Even very young men can remember when Alderman Welsh was only an experienced coal and wood dealer and Alderman Patterson a competent and careful undertaker. But the latent force which only needs opportunity to establish greatness was there. They became aldermen. Since then their expansion has been a public exhibition. The citizens of the whole town as well as their intimates and neighbors, have noted their gradually increasing breadth. . . .

Mr. Welsh has watched electricity feed into a dynamo and can now tell by the quality of the output whether the raw material was all used.

Were it not for the wonderful competency of these men we would feel alarmed when they tackle the next contract of the lighting commission. A lot of exciting dynamos, constant potential dynamos, with inconstant currents, rheostats for alternating currents, transformers of varying capacity in kilowatts and patent lightning arresters have been contracted for.

The public need not fear that these articles will not be up to the mark. Welsh and Patterson will see to this, and if there is any fault to be found Ed. Gilman will doubtless be heard from. They will see that the lightning arresters are provided with warrants that they may detain and take lightning into custody by due process of law.

And you can wager that the rheostats will be all right. Mr. Welsh will throw a pile of them on his coal scales and if they are not up to the mark, back they will go. Nothing will warp his judgment when he comes to those amperemeters. They must be right; absolutely correct in pattern and quality.

But it is when he shall come to the transformers that he will call in Expert Alderman Patterson. If they vary as much as the fraction of a kilowatt from what they should be, these men will be heard from in the council chamber in no uncertain tones.

It is a great comfort to know that we have men in the city government who can detect a kilowatt in an alternating circuit or a polliwog in a water main with equal facility.

Better Buy American Made Batteries.

The Armour Institute of Chicago recently purchased abroad some storage batteries for the laboratory, and held that they should not be dutiable, being for educational purposes. After some controversy, the Board of General Appraisers has decided that they are subject to duty.

The Lighting of the Bridge Cars.

The contract for lighting the cars on the Brooklyn Bridge has been awarded to the Electrical and Mechanical Engineering and Trading Company. There are to be ten lights, each of 16 candle power, in each of the sixty cars. For the plant the company is to receive $18,135, and the cost of maintenance will be $1,350 a year.

The Reception – Capitol City Club.
EXPENSES
Railroad fare $32.00
Sleepers 12.00
meals 8.00
hotel 16.00
Carriage 24.00
cabs 1.00
Sundries 178.60
271.60
$197
$258
ORDER BLANK
The Barbecue
A Recollection of Atlanta
R. F. Outcault.
Anxious for the next Convention
Chorus of Cashiers – (to returning delegates) You must have had a h – l of a time!
The Banquet at the Kimball House.

ATLANTA—A RETROSPECT.

ECONOMICAL PRODUCTION OF POWER BY ELECTRICAL DRIVING.*

In the able address of Prof. Kennedy before the Institution of Mechanical Engineers the subject of economical production of power by electrical driving was very fully dealt with, and at the late meeting of the Iron and Steel Institute at Brussels a very interesting and instructive paper was given by Mr. Selby Bigge, which conclusively showed the importance and possibilities of the system. At the risk of rendering this address narrow, and more in the form of a paper, rather than general, I propose to give some illustrations of the applications of electrical driving, both in this country and abroad, hoping that a *résumé* of what has actually been accomplished may promote a discussion which will thoroughly ventilate the question and be fruitful in beneficial results. With the late disastrous record of the shipbuilding and engineering industries, as an example, it is highly improbable that any capitalist will start a new shipyard amongst us, so that we may be sufficiently selfish to consider the application of electrical driving to existing works only. The first question to consider, therefore, is that having boilers grouped in one place from which steam is led to engines distributed over a large area, what economy can be expected from substituting those engines with electric motors supplied with power from a central station, and will the results justify the expenditure? We are all thoroughly aware that condensation does occur in steam pipes, and that the present engines are uneconomical, but a broad view is generally taken of the matter, and little has been done to ascertain what the results really are. It is for this reason that the experiments and developments made by Mr. Panton, of Messrs. Dorman, Long & Co., of Middlesborough, in conjunction with Mr. Selby Bigge, are of the greatest value, and particularly so as they have resulted in complete success. The original steam driven machinery comprised punching, shearing and bending machines, cold saws, etc., all of which were distributed over a large area and driven by six engines capable of indicating the following powers, viz., 27, 14, 14, 14, 16 and 9. These engines were disconnected and replaced by motors of 10½, 3½, 5, 3½, 3½, and 3½ horse-power respectively, the driving gear consisting of a belt from the motor direct to the flywheel of the machine. The most noticeable case is where a large bending machine formerly driven by an engine having a cylinder 10 ins. diameter with a stroke of 12 ins. is now efficiently worked by a 3½ horse-power electric motor. The current for these motors is generated by a 50 horse-power Pieper dynamo driven by an ordinary horizontal engine, the steam being obtained from two Lancashire boilers which were already in use in connection with the steam driving of another portion of the works. Formerly the six engines in question were supplied with steam by two boilers, which are now dismantled, with the result of a net saving of 30 tons of coal per week and the entire labor in connection with stoking and upkeep.

Another striking advantage is that the speed of the motors, being practically constant under all loads within their capacity, the machines driven by them are always running at the desired speed, and are therefore in a condition for producing the greatest possible amount of work. In reviewing this plant we have the advantage of ascertaining the approximate loss resulting from condensation in a long range of steam pipes, and the working of small high-pressure engines under conditions usually found in iron works and shipyards. It will be apparent, however, that the generation of power at one center admits of an economy beyond this, viz., the use of a modern high-pressure triple-expansion condensing engine, with a consumption of 12 to 14 lbs. of steam per I. H. P. per hour, instead of a consumption of from 40 to 60 lbs., as frequently is the case at present. It is evident that the loss in such a case as that of Messrs. Dorman, Long & Co. may be termed a maximum, on account of the machines working in the open air, and the steam pipes led underground, but the results from ordinary cases of shop machinery are often sufficiently startling to warrant more attention being given to them than they usually receive. For purposes of comparison we will consider the results obtained from two works of about equal driving power, one having an electric installation and the other steam.

One of the most complete installations of electrical driving in the world as applied to large industrial establishments is that of the National Arms Factory at Liége, Belgium. These works were built in the year 1889, and are of very large extent, employing 2,000 hands, the daily output of finished rifles being 250. Some idea of the system adopted, and the value of machinery for economical and rapid production, may be formed when it is considered that there are about 58 parts in a complete rifle and bayonet, involving in their production about 750 operations; yet so great has been the development of machine tools used in this manufacture that, of the 750 total operations, only 6 per cent. are performed by hand labor. Another feature is that a large percentage of the machines are automatic, and advantage is taken of this by placing several in the charge of one operative.

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* Abstract of President's inaugural address, North East Coast Institution of Engineers and Shipbuilders, England.

The whole of the machinery is driven by electric motors receiving their current from one central dynamo coupled direct to a Corliss condensing compound engine having two cylinders and indicating 500 horse-power at 70 revolutions per minute, with a boiler pressure of 90 lbs.

The auxiliary feed and condensing water is supplied by a pump driven by a 10 horse-power motor, receiving its current from the main generating dynamo, and placed on the canal bank 2,840 feet distant and 117 feet below the level of the engine.

The water after being used in the condenser is discharged into a tank placed 40 feet high, from which it passes through finely perforated pipes in the form of spray into an open reservoir on the ground level, and by this means is reduced in temperature so as to be again available for condensing purposes.

The generating dynamo is placed between the high pressure and low-pressure engines, and the armature being on the main shaft acts as a fly-wheel. The armature, which is 16 feet in diameter, was constructed in place. The electro-magnets are twenty in number, and there are 40 pairs of brushes, 20 on each side. The capacity of the dynamo is 3,000 amperes at 125 volts and the makers guaranteed an efficiency of 90 per cent.

The current from this powerful generator is distributed to about thirty-one motors ranging from 3 to 50 horse-power, placed in different sections of the works.

The machines used in the manufacture of rifles are necessarily of light design, consequently the motors are arranged to drive line shafting only and although the total length of main shafting exceeds 4,000 feet and the total length of belting is about eleven miles; there are no indirect main drives, a motor driving one line of shafting only, the object in view always being the reduction of loss by friction.

Each motor is provided with an ammeter, and as those in charge know the amount of power required to drive the machines when being worked to their desired capacity, any increase of that power at once indicates that there is a waste in friction, whilst any decrease indicates that the machines are not doing sufficient work; and when it is remembered that the revolutions of the motor are practically constant under all loads within their capacity, it is impossible to imagine an arrangement which so exactly fulfils the requirements of maximum economical production.

Compare this with the wasteful arrangements so common in shipyards and engine works, where engines, often already fully loaded, have to drive still another new tool, and the "make-the-best-of-it" policy of giving just a little later cut-off is adopted. The result generally is that the mean revolutions of the main shaft are not only decreased by any variation in load, but are, in addition, highly sensitive to the variations of steam pressure. This is, however, a diversion, and referring again to the Liége factory, there is also a 300 horse-power Willans engine, coupled direct to a dynamo, which generates the current necessary for frequent extensions.

It has been found by careful experiment that the consumption of steam in the Corliss engine is about 14 lbs. per I. H. P. per hour, whilst the losses are 10 per cent. in engine friction, 10 per cent. in the dynamo, 2 per cent. in lines, and 15 per cent. in motors, or a total efficiency of 63 per cent. at the motor driving pulleys of the indicated power of the generating engine. The whole of the electric installation was made and fitted by the International Electrical Company of Liége from the designs and under the direct superintendence of Mr. H. Pieper, the managing director and electrician in chief of the company, and we have an ample testimony of the efficiency of the entire plant in the fact that, although the works have been running over three years and a half, there has not been one single stoppage of the main dynamo during working hours, and no accidents of any kind whatever.

Particulars such as these are always of general interest, but any radical change made in existing works involves a considerable outlay, and extreme care is necessary to be certain that such a change would be commercially successful.

An example of what may be termed ideal electrical driving is that of the Bedson Wire Company of Middlesborough, where the installation is the most perfect and complete that has as yet been attempted in this country. Every process connected with the manufacture of wire is carried out by means of electricity, the wire drawing, galvanizing, spinning, and barb fencing machines, overhead and locomotive cranes, hydraulic pumps, induced draft fans, lathes, centrifugal pump, are all independently driven by electric motors. Owing to the entire absence of shafting and belting the construction of the building is very light, and the convenience of the whole plant is most noticeable. The current is generated by a 600 horse-power dynamo driven direct by a three crank triple condensing engine with boiler of 160 lbs. pressure. A special tunnel, 350 yards in length, has been constructed for the conveyance of the conductors, and branches are taken from these to the fifty motors which vary from 5 to 40 horse power each. The lighting of the works is most complete, the greater part being carried out on the inverted arc principle, which is so perfect that there is an entire absence of shadows. The original plans for driving these works electrically were prepared by Mr. Selby Bigge, who appears to have given considerable attention to the question of electric driving. Before definitely deciding to put down such a novel plant several experiments were necessary, for which purpose special machines were designed by Mr. Bedson, the managing director of the Bedson Wire Company. These experiments were made at Liége by Mr. H. Pieper, and were so successful that after an exhaustive series of tests the directors of the company decided to adopt the electrical installation in its entirety.

A novel feature in connection with the boilers at Messrs. Bedson's works is the application of Messrs. Ellis & Eaves' well-known system of induced draught. This is the second application of the system to land boilers, the first having been made at the Atlas Works, Sheffield, originally arranged with Lancashire boilers. These have gradually been replaced by ten single-ended boilers of the marine type, the advantages claimed being as follows :

1. Considerable economy compared with the Lancashire boilers with Galloway tubes.
2. Considerable reduction in space occupied.
3. Absence of smoke.
4. Greater elasticity of power.

In ordinary work, by maintaining a vacuum of 3 inches at the fan, the combustion is at the rate of about 35 lbs. per square foot of grate surface, and one single-ended boiler can readily evaporate as much steam as three Lancashire boilers 27 feet by 7 feet, with ordinary chimney draught. Where the demand for steam varies in a works, the system is a great convenience, and this is especially the case for electric light installations. It is evident that with this system of draught, or with any other efficient system, the assumed consumption of thirteen tons per day could be still further reduced.

From the comparison which I have made, we may fairly conclude that the saving gained by the substitution of electrical driving in an old-established works would be considerable. Whether this saving would justify the outlay in all cases would have to be settled by those who have their capital invested in works suitable for its adoption. I may say, however, with reference to the firm of which I am a member, that for some time we have had the matter under consideration, and the various investigations and experiments made by Mr. D. B. Morison, and of which are those enumerated in this address, have so convinced us of the commercial possibilities of the system that we have now on order a small plant prior to further developments hereafter.

I have endeavored to confine myself in my remarks to a plain statement of what has been accomplished by making use of electrical power to drive machinery, and have not gone into any of the possibilities the future may reveal.

We have known the science of engineering to advance at times as it were by leaps and bounds, and from the rapid strides that this comparatively new energy has made within the last few years, we may have reasonable expectation of still further development in this direction.

In the address which I have given to you this evening, I feel that I have but inadequately fulfilled the task imposed when you conferred upon me the honor of electing me president of this valuable and widely known Institution, but hope that my remarks will be productive of help in the work before us. That the suggestion of the possibility of further expenditure of capital is unpalatable to many members of this Institution, I can well believe, seeing what dark clouds are hanging over us, but let us hope that, as in past times, the clouds will have a silver lining and shortly disperse, giving place to the pleasant sunshine of renewed commercial prosperity of which both capital and labor will receive their just and fair proportion.

Luminescent Electric Lights.

Mr. H. Ebert recently contributed a paper of great interest to *Wiedemann's Annalen* on the production of light by high frequency currents, in which results are indicated which are likely to prove of the utmost importance. The fundamental difference between the light and that associated with Tesla's name seems to be in an insistance upon the principle of resonance. He says that it is not necessary to use high tensions since it has been found that intense light effects can be produced by the movement of exceedingly small quantities of electricity, provided only that the oscillations follow each other regularly and are persistent. The luminous substance of Ebert's "luminescent" lamp is said to be a small disk of compressed luminous paint. This is enclosed in an exhausted glass receiver upon the external surface of which are glued two strips of tin foil to which the terminals of the circuit are attached. When the electric oscillations act upon these coatings, active cathode rays are formed on the inner surface. These, though almost invisible themselves, produce a strong luminescent light upon the surface of the luminous paint.

To determine the efficiency of the lamp it was compared with the amyl acetate standard. Its candle power was found to be about $\frac{1}{30}$ of this, which is approximately equal to the standard candle. It was found that the energy actually expended in producing this light was only about one millionth of a watt.

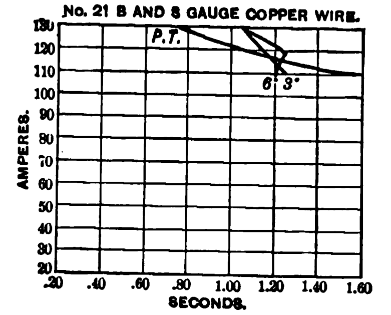
Destructive Arcing of 500 Volt Fuses.*

BY W. E. HARRINGTON.

The destructive effects of the arc accompanying the opening of 500 volt circuits with switches, lightning arresters and fuses, has led the writer to inquire into these phenomena, particularly in reference to fuse practice. A series of carefully conducted tests were made to find the relation between the fusing currents of different size copper wires ranging from No. 30 to No. 21, B & S. gauge, the time required to open the circuit, and to what extent the arc contributed to the time required.

An inclined trackway was constructed, having two copper tracks upon which a traveler, consisting of a block of hard wood having copper plates in contact with the tracks could run, the circuit from rail to rail of track being completed through an electro-magnet on top of the traveler. Parallel with and alongside of the track was a raised board, on which a paper was attached.

No. 21 B AND S GAUGE COPPER WIRE.

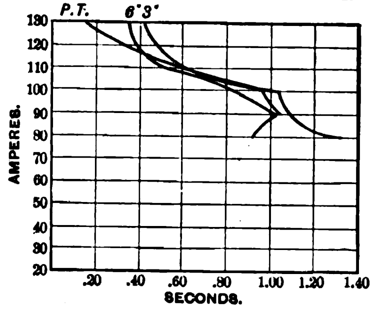


No. 1.

An impress was made on paper by a lever on the traveler, when released by electro-magnet, owing to stoppage of current.

Before tests were made the trackway was carefully calibrated as regards time for traveler to go from top to bottom and the intermediate points, resulting in knowing the time to $\frac{1}{100}$ of a second.

No. 22 B AND S GAUGE COPPER WIRE.



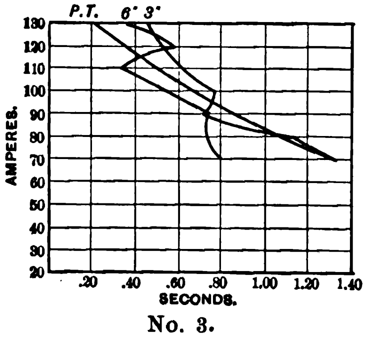
No. 2.

The tests were conducted across the bus bars of switchboard of the Camden Horse R. R. Co., Camden, N. J. Average voltage, 515 volts.

Before throwing a fuse in circuit a water rheostat was set, using a Weston ammeter for this purpose, so that the current desired would flow through the fuse when the circuit was completed by the traveler on the trackway.

The different size fuse wires were subject to the following limitations: the time of the traveler running full length on the trackway, 1.5 seconds; the current ranging from 20 to 130 amperes in 10 ampere steps.

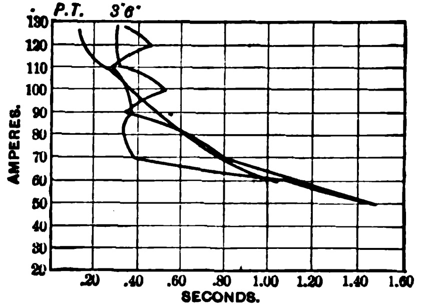
No. 23 B AND S GAUGE COPPER WIRE.



No. 3.

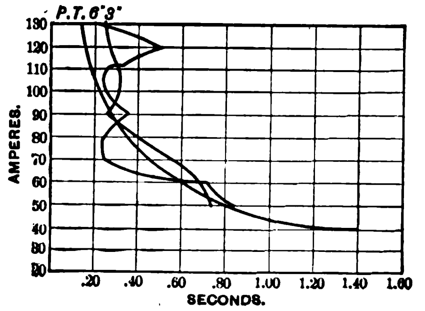
The smaller fuse wires would fuse with the minimum current of 20 amperes, and in all instances inside of the 1.5 arc limit. Consequently the curves show a wide range, but in the larger size wires a greater current was required to fuse the wires in the 1.5 second limitation, consequently the curves given for the larger fuse wires show less and less range as the fuse wires increase in size.

No. 24 B AND S GAUGE COPPER WIRE.



No. 4.

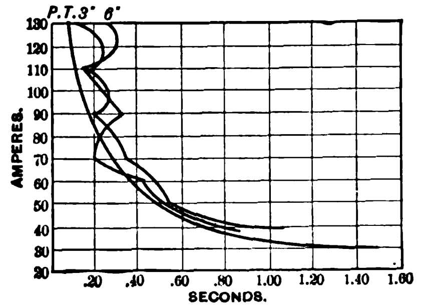
No. 25 B AND S GAUGE COPPER WIRE.



No. 5.

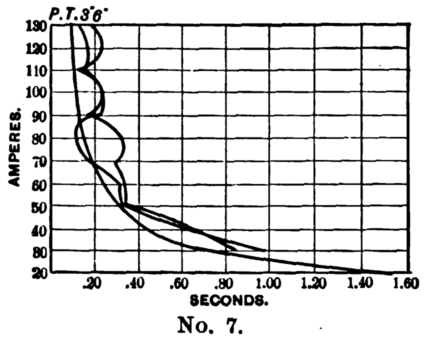
In order to strike an average the tests were repeated under similar conditions as regards current and gauge wire with a 3" horizontal fuse, a 6" vertical fuse, both of which were connected to a standard form of fuse block; also a 4½" fuse, the average in length of the 3" and 6," was employed connected in a specially constructed fuse block, which absolutely prevented any arcing of the terminals. In other words, the fusing of the fuse wire could not burn the terminals to which it was attached.

No. 26 B AND S GAUGE COPPER WIRE.



No. 6.

No. 27 B AND S GAUGE COPPER WIRE.



No. 7.

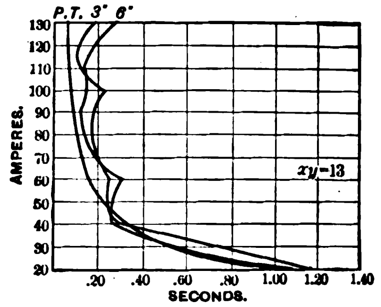
The results recorded graphically in the accompanying charts give, therefore, the time required in fractions of a second for the circuit to be opened under identically similar conditions as regards current and gauge of wire for a 3", a 6" unprotected and a 4½" protected terminal fuse.

The curves as given in chart No. 8 for No. 28 B. & S. copper wire illustrates excellently the erratic character of the fusing of wires under conditions as observed in the practice of to-day.

While the tests as herein recorded show no superiority of the 6" unprotected terminal fuse wire over the 3" unprotected terminal fuse wire, the 6" fuse wire is unquestionably safer when conditions are more extreme, such as, for instance, when a short circuit occurs.

The determining factor in the matter of fuses is: What are the conditions required to protect against absolute short circuits across the bus bars of a large power station 500 volt switchboard? Tests are conducted showing how fuses act under conditions that are predetermined, certain currents which are made to flow, etc., but you never see anything published or advice given in this matter of fuses for the condition which really occurs the most frequently, that is, absolute short circuits.

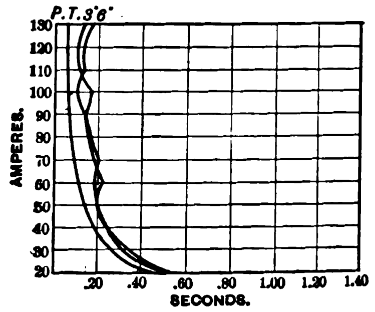
No. 28 B AND S GAUGE COPPER WIRE.



No. 8.

Now the requirements and limitations as prescribed in the Board of Fire Underwriters' report are true and perfectly safe when the fuse "blows" under the conditions as outlined in the tests as made by the committee appointed to make such tests. But on an absolute short circuit across bus bars a 10 ampere fuse block constructed as specified will, instead of protecting one when most in need of such protection, burn up in the most vicious way, and will open magnetic cut-outs in a power station requiring currents up to a 1,000 amperes to open. Understand, the fuse does not itself do this, but the arc established at the expense of the terminals, is the immediate and sole cause, and the circuit must be opened elsewhere.

No. 29 B AND S GAUGE COPPER WIRE.



No. 9.

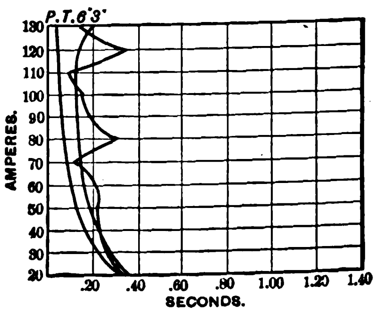
The conclusions one is forced to draw from the above tests and the general literature upon the subject of fuses are as follows:

First—The proper and only fuse block to be used is one having protected terminals.

Second—That fuse blocks should be furnished so that the terminals would not be burned under conditions approaching an absolute short circuit across the bus bars of a 500 volt power station.

Third—That magnetic cut-outs are immeasurably preferable under all circumstances.

No. 30 B AND S GAUGE COPPER WIRE.



No. 10.

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*Abstract of paper read at the American Street Railway Association Convention, Oct. 17-19, 1894.

Mail, Express and Freight Service on Street Railway Cars.*

BY RICHARD M'CULLOCH.

The first feature which strikes one in endeavoring to study a subject such as this, is the great difference existing between what are known as street railways. We have city roads and suburban roads· we have summer resort roads; we have belt roads operated by different motive powers, some of them almost approaching steam railroads. All these railroads haul different classes of passengers, bent on different errands, and are operated under different conditions. It is manifestly impossible, therefore, to lay down any fixed rule for mail, express or freight service—to say that it should be put into practice on street railways or that it should not be put into practice. This is a problem which must be solved for each railroad individually.

In order to ascertain as well as possible how much has already been done, a circular asking for information in regard to mail, express and freight service was sent to every street railway company in North America. Nine hundred and seventy-eight letters were sent out and 413 replies received. These replies are tabulated below.

The rate charged on express matter is usually five or ten cents per package, while the freight rates vary from four to ten cents per 100 pounds. The mail is usually carried under a direct contract with the Government, or under a sub-contract with a mail contractor. The income from the transportation of the mails varies according to the amount of mail, the number of trips per day, and the length of the haul, from $100 to $1,000 per annum.

TABLE OF MAIL, EXPRESS AND FREIGHT SERVICE IN NORTH AMERICA.

	Any Form of Such Service.	Under Contract with Express Co. or U. S. Government.	Haul Steam R. R. Freight Cars Over Street R. R. Tracks.	Operate Special Cars for this Service.	Carry Small Bundles on Passenger Cars for Pay.	Contemplate Such Service.	Distribute Matter Beyond Station.	Use Combination Express and Passenger Car.
Mail.........	62	58	......	5	......	10	......	.....
Express.....	35	8	......	9	31	7	2	8
Freight......	55	......	6	37	......	12	2	.....

That the street railways of this country are already alive to the possibilities of the mail service is shown by the table. Sixty-two street railways are now carrying Uncle Sam's mail, while fifty-eight have Government contracts. Most of these railways are suburban roads or roads joining towns; but the postal authorities realizing the advantage of quick delivery and collection, are now beginning to make arrangements with the large city systems for transportation of the mails from main postoffices to branches and for distribution and collection throughout the city.

The only method of handling a large mail service, in which it is necessary to collect and distribute along the route, and handle it satisfactorily both to the patrons of the road and the postoffice department, seems to be in the use of a separate car—an independent mail car in charge of a railway mail clerk. This system is already in use on street railways in St. Louis, Brooklyn and several other places, and so far as we can learn is giving excellent satisfaction both to the railway companies and the postoffice authorities. The mail is quickly and promptly handled; the service is regular and certain; great and small quantities of mail may be collected and distributed with equal facility, the residents along the line are greatly accommodated, and no interruption or inconvenience to the passenger traffic results.

Where the mere carriage of the mails in pouches from the main postoffice to branches, or from depots to postoffices, is undertaken and there is no attempt made at collection or distribution along the route, there can be no objection to carrying the mail sacks on the front platform if their number is not too great; but passenger cars should not be stopped and held for mail collections, nor should valuable space within a passenger car be taken up with mail sacks.

An advantage, independent of any financial return, and one which is regarded by many as the one reason for street railways embarking in this service, lies in the prestige of Uncle Sam's name. This point was never so thoroughly illustrated as in the late labor troubles in Chicago. Rioters may have no fear of the city police or of the State militia, both of whom are often entirely in sympathy with them, but they regard with the greatest awe a company of regulars armed with Springfield rifles. Uncle Sam will tolerate no interference with the distribution of the mails, and no other point has been so thoroughly impressed upon the dangerous element in our communities during the last year. Some railway managers on securing mail contracts have proposed to paint upon each car "U. S. Mail," as a kind of official notice that their roads are under the protection of the Government. How effective will be the protection against blockades and riots, and how great a moral influence this will exert to prevent strikes and other stoppages, remains to be seen.

The answers to the circulars showed that thirty-five roads are now engaged in the express business, while fifty-five are hauling freight. As a matter of fact, however, few roads through the country are doing a regular freight business, most of the so-called freight services partaking more of the nature of express. As operated upon street railways, the distinction between express and light freight service is so ill-defined that it is deemed best to consider both subjects together.

The operation of an express service on large city systems has not been attempted to any great extent, but it has been contended by some enthusiasts on the subject that a street car express service will eventually take the place of the many city deliveries and city express wagons now in use. As an example of a city road operating an express and freight service involving collection and a house to house delivery, it would be interesting to cite the case of the Southern Railway of St. Louis, which has been operating an express service on this plan for almost two years.

The especial feature of this service is the collection and delivery. This is effected by means of wagons, two of which are kept at the down town end of the road, and three of which meet the car on all trips at certain points along the line. On receiving notice by mail, telephone, or otherwise, a wagon calls for a package, delivers it at the car, from which it is handed to the proper wagon and delivered to the address marked on the package. A charge of ten cents per package is made for this delivery, and trunks are taken from houses to the Union Depot, checked, and the checks returned, for the sum of fifty cents. A corresponding charge according to size is made for the delivery of large boxes and bundles. A compliment to the efficiency of the service is paid by the large dry goods and clothing houses, which have ceased to run their delivery wagons into this part of the city and now consign all of their bundles to the railroad company. Where formerly one delivery daily was made by the wagons, three are now made by the railway. An interesting feature of the service is that several large factories located in the southern part of the city consign all their freight to the electric express. The goods are put on the car, taken to the proper railroad stations, shipped, and the bill of lading returned to the consignor. Packages are received by the express car C. O. D., the charges collected, credited to the proper account, and settlements made at the end of each month. The railway company assumes all the responsibilities of a common carrier, holding itself liable for all loss and damages. It does not interfere with the regular running of the cars, and since its inauguration has never failed to pay.

Up to this point we have considered an express and freight service merely as a paying or non-paying institution, to be adopted in the one case and to be rejected in the other. There is another view which may be taken of the case, however, which is in many instances the most proper solution of the problem. This is to regard the establishment of this service merely as an auxiliary to the passenger traffic, to be operated whether or not it pays in order to gain increased passenger travel. The most notable instances of this sort are the roads which run from the hearts of our large cities out into the suburbs. It is manifestly to the interest of these roads to promote building and settlement along their lines, and how can they better attract builders than by giving their patrons all the advantages of city life, not only in furnishing them with rapid transportation to and from the city, but in aiding them in receiving their provisions and supplies. This calls for some form of express service, and although the receipts from this source may not equal the expenses, the increased passenger receipts and the advertisement given the road must also be taken into account.

In all street railway practice the cardinal point of any service, whether mail, freight or express, must be that it does not interfere in the least with the passenger travel, and this point should always be kept in view in the arrangement of such a service. For this reason we would strongly advocate the use of separate cars, operated by separate motive power and by separate men. In roads between towns, or suburban roads operated on the same plan as a steam railroad, where stops are made only at certain stations, a combination car or a trailer might be used; but in city roads the system of piling trunks and boxes inside the passenger car and on the front platform, and stopping for these to be put on and taken off, is not of the era of the electric railway.

Information received from several of the States shows that in some places the transportation of freight or express over street railway tracks is prohibited by State law or municipal ordinance, and it has been suggested that associations of managers of street railways in those States be formed for the purpose of securing favorable legislation. The enactment of these laws may be due to hostile steam railroad influence or it may be due to a misconception of the nature of the services which street railways would put in operation. Surely a smooth-running electric car, moving swiftly onward, would not prove such a nuisance as the great lumbering wagons which block the streets of our large cities. Where a freight or express service is needed, the accommodation to the public would be so great that many citizens might be enlisted on the side of the railways to secure the proper legislation.

In closing, it would perhaps be well to note some of the principal points which, it is hoped, have been brought out in this paper:

1. That a mail service involving collection and distribution is best handled on a separate car, operated on the same plan as a U. S. railway mail car.

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*Abstract of paper read at the American Street Railway Association Convention, October 17–19, 1894.

2. That it is supposed that a great advantage arising from the transportation of the mails comes from the fact that the road is under the protection of the Government, and is thus secure from riots, strikes and blockades.

3. That the most promising opening for an express or freight service is a road running between two towns, or a city road running through well populated suburbs.

4. That the question whether or not such a service will pay is entirely a local question, and must be estimated for each road separately, under existing conditions.

5. That there are cases when it would be advisable to operate such a service, independent of the profits, in order to accommodate the patrons of the road and to induce building along the line of the road.

6. That such a service operated upon the ordinary street railway must not be allowed to interfere in the least with the passenger traffic.

7. That in States having laws prohibiting this service, associations of railway managers should be formed to secure favorable legislation.

The Chemical Theory of Accumulators[1]—III.

BY E. J. WADE.

Very few additions were now made to the chemistry of the cells for some little time. The excess of sulphate formed under certain conditions and the extreme difficulty with which it was again reduced still continued to puzzle investigators and seemed to point to the existence of two different kinds, one reducible and one not. Various theories of double sulphates, basic sulphates, and so on, were developed to meet the occasion, but had very little evidence to support them. In 1889[*] Dr. Frankland made some experiments which seemed to indicate the existence of two basic sulphates obtainable by the action of sulphuric acid on litharge and minium respectively, but both Messrs. Gladstone and Hibbert[†] and Mr. Robertson[‡] consider they are only mixtures of normal lead sulphate with more or less oxide.

The paper by Prof. Ayrton and others on "The Chemistry of Secondary Cells," read before the Institute of Electrical Engineers at the end of 1890,[§] did not propound any new theory of their action, but supplied some very interesting data, both qualitative and quantitative, as to the composition of the plates at various stages of charge and discharge. Their investigations also included an examination of the temperature changes of a cell during charge and discharge, and these, together with some experiments made by Messrs. Duncan and Wiegand about the same time, and communicated to the American Institute of Electrical Engineers in May, 1889,[¶] form the first definite contributions to this branch of the subject. In both papers attention is called to the remarkable fact that a cell actually cools during discharge.

So far, almost all the investigations into the chemistry of the cells had been confined to an examination of the changes taking place at the electrodes, and very little attention had been paid to any reactions occurring in the electrolyte; but the researches of the last three or four years seem to indicate that there really lies the explanation of many obscure points.

Planté had, indeed, observed the formation of some unstable compound containing "active oxygen," which he thought to be hydrogen peroxide (H^2O^2), and he ascribed the initial E. M. F. of a freshly charged cell to its presence; but, to suit the needs of the "occluded gas" theory, it was assumed that the real agent was oxygen, liberated at the positive electrode in the form of ozone, and this idea has prevailed more or less generally to the present day.

In 1878 Berthelot discovered the highly-oxidized compound persulphuric acid, and showed that it was a direct product of the electrolysis of dilute sulphuric acid, while hydrogen peroxide, whose presence under similar conditions had long been known, was chiefly a secondary product resulting from its subsequent reversion to normal sulphuric acid.

$$H^2 (SO^4)^2 + 2H^2O = H^2O^2 + 2H^2SO^4.$$

In 1883[*] Messrs. Gladstone and Tribe noticed persulphuric acid in some solution that had been subjected to electrolysis; but Prof. Armstrong and Mr. G. H. Robertson, in 1891[†], were the first to call attention to the probability of this compound being the cause of the variations of E. M. F. and other phenomena observed in the cells, and the latter gentleman discussed the matter in more detail in a paper read before the Society of Arts in the same year.[‡] He showed that persulphuric acid and hydrogen peroxide were formed in considerable quantities at the positive electrodes of a cell during charging, their relative proportions depending on the strength of acid that was used; and, further, that the latter compound was capable of causing local action and ultimate sulphating at both electrodes. He also considered that a cell's E. M. F. was in some way dependent on the amount of these compounds present, but his experiments on this point were not very definite or conclusive.

Meanwhile Messrs. Gladstone and Hibbert had commenced an investigation of the relations of the electrolyte to the E. M. F. from the point of view of the strength of acid. Their first results were communicated to the Physical Society in 1890;[††] but in a very interesting paper "On the Cause of the Changes of Electromotive Force in Secondary Batteries," read before the Institute of Electrical Engineers in 1892,[‡‡] they go much more fully into the matter. Messrs. Duncan and Wiegand, in their communication referred to above, had already shown that during discharge the strength of the solution contained in the pores of the active material might be very greatly reduced by the abstraction of sulphuric acid to form sulphate with the production of water far faster than it could be equalized by diffusion from the surrounding liquid; and, following up this line of argument, Messrs. Gladstone and Hibbert endeavored to prove that the loss of capacity and E. M. F. with heavy discharges and subsequent recovery on standing, the high E. M. F. observed immediately on the cessation of charging, and the normal variations of E. M. F. during charge and discharge would all be accounted for in a similar way. Although in some points, perhaps, the deductions drawn from their experiments are stretched to cover rather more than can be explained by their aid alone; yet, on the whole, they supply a thoroughly well-connected chain of evidence and reasoning, from whose main conclusions it seems difficult to dissent. During the discussion that followed their paper, Mr. Robertson advanced some further arguments in favor of the persulphuric in the electrolyte being the real cause of the variations of the E. M. F., and Messrs. Gladstone and Hibbert again returned to the subject from their point of view in a communication to the Physical Society shortly afterwards;[§] but since that time no direct evidence bearing on the point in dispute has been adduced.

The last contribution to the chemistry of lead storage cell worth noticing is that of M. M. G. Darrieus, read before the Société Internationale des Electriciens in May, 1892. The author advances some theories of their action so widely at variance with those generally accepted and the results obtained by other experiments that they would require a considerable amount of confirmatory evidence to sustain them, especially as the details given regarding the apparatus used and the methods of electrical measurement employed are very meager. He is strongly of opinion that the formation of lead sulphate at the positive electrode is purely a secondary reaction, the reduction to litharge being the essential one. Further, in order to account for the high E. M. F. of the cell, he maintains—and it is here that the originality of his views is most apparent—that the porous lead of the negative electrode prepared by electrolytic reduction, is in a highly energized allotropic condition something similar to "explosive antimony"; and that consequently it furnishes far more energy and E. M. F. by its conversion into lead sulphate than lead in its normal metallic state. Besides this, he considers that the sulphating takes place in two stages; first an oxidation of lead to sub-oxide (Pb^2O), and then a conversion into lead sulphate with the elimination of water; half the lead, however, returning to the metallic state, and being protected from further action by the surrounding sulphate.

$$Pb^2O + H^2SO^4 = Pb + PbSO^4 + H^2O.$$

Although it may be impossible to agree with the whole of the conclusions drawn by M. Darrieus from his researches, yet at the same time his paper is well worth study both for its originality and suggestiveness, and some of his experiments might well repay repetition. With the exception, however, of a passing allusion to it by Dr. Gladstone, the paper does not appear to have attracted much notice in England.

In attempting to select from amongst the various theories of the action of lead storage cells the one which best corresponds to the facts of the case, two classes of evidence must be considered. Obviously there is the direct evidence afforded by analyses of the electrodes and electrolyte and quantitative determinations of the different compounds present at various stages of charge and discharge, while the corresponding physical changes in the electrical resistance of the cell, color and appearance of the electrodes, and so forth, should also furnish some supplementary evidence. But besides these there is very important indirect evidence to be obtained from comparisons of the observed E. M. F. of the cells with that calculated by means of thermo chemical data; and if, for any assumed set of chemical reactions, a real agreement can be shown between the observed and calculated values, strong prima facie evidence is afforded that these are the ones actually occurring. It may be as well to state the law governing these calculations and to show briefly both how it is derived and how applied, for very little information on this subject is to be found in any works on electricity.

The fundamental laws of electrolysis, first discovered by Faraday, are as follows:

1. The quantity of an electrolyte decomposed by a current is directly proportional to the strength of the current and its duration; that is to say, to the whole quantity of electricity that passes through it.

2. The quantity of each electrolyte decomposed by a unit quantity of electricity is perfectly definite and constant, and is termed its "electro-chemical equivalent."

3. The quantities of different electrolytes decomposed by a unit or any other given quantity of electricity and in direct proportion to their chemical equivalents or combining weights.

The nomenclature now generally used in dealing with electrolytical matters was also devised by Faraday. He called the component parts (not necessarily elements, but oftentimes compound radicals or groups of elements such as SO^4, NH^4, and so on), into which an electrolyte is split up by a current "ions," those liberated at the electrode by which the current enters being "anions," and the electrode itself the "anode;" and those liberated at the electrode by which the current leaves "kathions," and the electrode the "kathode." Nearly all the tables and data relating to electro-chemistry and thermo-chemistry are given in terms of the gramme as the unit of weight, and the coulomb or ampere-second as unit of electricity; but otherwise calculations could equally well be made in terms of the more commercial units, the pound and the ampere-hour.

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[1] From *The Electrician*, London.

[*] Proc. Royal Society, Vol. XLVI (1889), page 304.

[†] Proc. Physical Society, Vol. X (1890), page 448, and Vol. XI (1890), page 44.

[‡] Proc. Royal Society (Vol. L (1891), page 105.

[§] Journal Inst. Elec. Engineers, Vol. XIX, page 660.

[¶] *Electrical World* (New York), June 15, 1889.

[*] Journal Chemical Society, 1883, page 345.

[†] Proc. Royal Society, Vol. L (1891), page 105.

[‡] Journal Society of Arts, Vol. XL (1892), page 44.

[††] Proc. Physical Society, Vol. X (1890), page 448.

[‡‡] Journal Inst. Elec. Engineers, Vol. XXI, page 12.

[§] Journal Physical Society, Vol. XII (1892).

It follows, from the last of the above laws, that the weights of the component parts or ions into which any electrolyte is decomposed will also be proportional to their chemical equivalents. Thus 74·5 grammes of potassic chloride will split up into 39 grammes of potassium and 35·5 grammes of chlorine.

It also follows that, knowing the weight of any one element liberated by a unit or a given quantity of electricity, the electro-chemical equivalent or the weight of all the others can be determined. Tables giving the electro-chemical equivalents of the elements may be found in many works on electricity, and are arrived at by multiplying their chemical equivalents into the electro-chemical equivalent of hydrogen. According to the most recent determinations, the electro-chemical equivalent of hydrogen in grammes per coulomb is 0·00001038. Chemical equivalents or combining weights must not be confused with atomic weights; but, with a few exceptions, they are the atomic weight divided by the valency. For example, both the combining and atomic weights of hydrogen are 1; but while the atomic weight of oxygen is 16, and of aluminium 27·3, their combining weights are only $\frac{16}{2} = 8$ and $\frac{27 \cdot 3}{3} = 9 \cdot 1$ respectively.

(*To be continued.*)

Personal.

Mr. Charles D. Shain, who is now able to travel for the first time in several months, has gone to Chicago.

Mr. W. C. Bryant, of the Bryant Electric Company, was in the city last week.

Mr. R. Anderson, electrical contractor of Ottawa, Canada, has been in the city for a few days making large purchases of supplies.

Mr. E. J. Hathorne, receiver of the Ft. Wayne Electric Company, who has been in Boston for some time, stopped over in New York on his way to Ft. Wayne.

Mr. P. H. Alexander has returned to New York after an absence of several weeks in New England.

Mr. James Godfrey, of the New York Insulated Wire Company, went to New Orleans after the Atlanta Convention, and will make several stops in the South, returning about November 1.

Mr. Edward Weston, whose health has not been good of late, will soon take a European trip of two or three months' duration.

The marriage is announced of Miss Amy Sweeny and Mr. Fred. S. Kenfield, of the *Street Railway Review*, at Rock Island, Ill., on the 24th inst.

Exit Cable, Enter Trolley.

The announcement is made that the Baltimore Traction Company will abandon the cable on its Gilmore street line and will adopt the trolley system. Experts have shown that a saving of $20,000 a year will be made by the change.

Cheaper to Ride Than to Walk.

All the street cars in Savannah are crowded nowadays. There were recently carried in one day 50,000 passengers altogether, which would average a ride for five-sixths of the entire population.

The fare is one cent on all lines but one, and tickets at the rate of two for a cent are talked of if the rate war continues.

One of the companies wants a subsidy now, and say they will present to the city council the argument that as cheap riding has been found to be such a good thing free riding would be better, and that it is proper that the city should make an appropriation to defray the expenses of the street railway companies for this purpose.

Some such arrangement will be necessary if any of the companies are to avert bankruptcy.

FOREIGN NOTES.

(CONTRIBUTED BY G. WILFRED PEARCE.)

A befogged British writer of scientific news for a Sheffield newspaper was recently puzzled by the phraseology of a United States patent issued to Hiram S. Maxim for a flying machine; he wrote to *Engineering* for a lucid explanation of the Americanisms in the Patent Office document, and the astute editor of that excellent journal of progress in the arts and sciences, referred the matter to "Our Own Hiram," who responded in a long communication in which he says that the language of the Patent Office paper is "elegant and euphonious, but is not Anglo-Saxon English," so he translated the document into English, and by latest advices from Sheffield, Her Majesty's Government had not been called upon to notify the Foreign Office of the assault with intent to kill the Queen's English that was made upon Maxim's caveat.

Lord Kelvin has recently completed a contract to supply all the ships in the Royal Navy with his patent electrical compass, which is the only one approved by the Lords of the Admiralty. Lord Kelvin's health is robust at the present time, and a few days ago he surprised and delighted his friends by making an oration at the unveiling of the bronze monument of Sir William Pearce, the famous shipbuilder and the first man who introduced electric lighting into ships.

Siemens Brothers' Electrical and Cable Works at Charlton, Eng., have been recently equipped with fifty-four electric motors, and all the shafting has been removed from the works.

The Cottage Industries Society of England has recently issued a pamphlet for distribution to the small goods makers in Warwickshire, in which the use of electrical motors is commended, and figures are printed showing the saving over other sorts of power.

The "penny in the slot" electric light used in the underground railway in London is not the success that was anticipated, as the workmen persistently put pieces of lead and iron into the slots and enjoy a "free blow" at the company's expense.

Electrical sanitation and water purification are not new; both processes were known and used in Italy and France before 1777, as may be seen by referring to copies of "the Encyclopædia Britannica" for the year 1777. In the same book are recorded experiments in growing vegetables, grapes and flowers in electrified soil, and if the accounts may be believed, wonderful success attended the labor of the gentlemen of education and large fortune who conducted the experiments in the interest of science. The reasoning of the experimenters is not empirical in the remotest degree; on the contrary the reasoning is sound and forcible, so much so as to appeal to the understanding and respectful consideration of savants of to-day. Several of the experiments were carried out on a large scale, and batteries were employed of greater capacity than were ever used in this country, even by the largest electroplating manufactories in New England and the Middle States.

Boston Notes.

Among Boston visitors last week was quite a contingent from Columbus, O., including Mr. M. Poston, and Mr. J. A. Jeffrey, of coal-cutting fame. Each of these gentlemen was accompanied by his legal adviser. The object of their visit was to secure additional evidence in a case in which Mr. Poston is suing Mr. Jeffrey for a large sum of money for alleged violation of contract. This suit grew out of the attempt of the G. E. Company early in the days of the consolidation to gobble up the Jeffrey Mfg. Company, who knew how to make a good coal-cutting machine while the G. E. Company did not. The deal was about completed and was kicked over by Mr. J. R. McKee at a meeting at which Mr. E. I. Garfield was also present.

Other prominent men at present on a visit to Boston are Mr. H. M. Byllesby and Mr. M. P. Johnson, representing the Northwest General Electric Company at St. Paul. Our recent statements anent the Pennsylvania General Electric Company may have induced the thought in the minds of some of our readers that the condition of affairs in that company were worse than some others. That is not so by any means. They are not a circumstance to what is going to be disclosed in connection with the management and condition of the Northwest Company. Last June it was intended to place the Northwest Company's affairs in the hands of a receiver as they were hopelessly involved. Just before taking that extreme step, however, it was realized that the moral effect would be disastrous to the parent company in the East at that time, so action was deferred as long as possible. A receivership for the company will no doubt follow closely upon Mr. Byllesby's Boston visit.

The new supply house of Thompson-Brown Electric Company, 95 High street, Boston, hung out its shingle on Thursday amid many promising and auspicious surroundings. The company has leased a large and convenient store with a roomy suite of offices and storage space in which they will carry a full line of electric light and railway supplies. Mr. G. Thompson, Jr., president, is a gentleman who has had eight years in the electric railway business; Mr. Maybin W. Brown, treasurer, is widely and favorably known through his long and successful connection in the field, and these gentlemen, supported by Mr. Fred. E. Pettingell, the pioneer electric supply dealer in New England, are bound to achieve success. Mr. Pettingell is a host in himself and he is heartily and sincerely welcomed back into the field. To know him is to like him, and he knows the business, too.

Three 500-light alternating current dynamos of the well known "Wood" type, and forming part of the Ft. Wayne Company's excellent system, have been sold the present week by Mr. E. I. Garfield, New England manager. Figures are being quoted on several big arc machines. Of course with the incandescent machines were sold the necessary adjuncts. This is not a bad week's work, and we are not surprised to hear that the New England salesmen of the General Electric Company are experiencing spasms in the abdomen.

That brazen-faced swindler, Mr. George B. Pennock, is still exhibiting his dollar extractor to the New England hayseeds, who part with their coin freely and unmurmuringly.

Mr. J. E. Talbot, who for the past six years was identified with the Ft. Wayne Electric Company, has become interested in the firm of Linton & Southwick, electrical engineers, Worcester, Mass.

To Push the Sale of Columbia Lamps in New York.

Mr J. H. Rhotehamel, president of the Columbia Lamp Company of St. Louis, has announced that his company have made arrangements to carry a large stock of lamps in this city, in order to make quick deliveries. Mr. C. I. Hills will continue as the New York representative of the company.

Canadian Notes.

There is a rumor current to the effect that a new electric road, in opposition to the Niagara Falls Park and River Railway on the Canadian shore, will be opened between Niagara Falls and Lewiston in the spring.

The stock of the Montreal Street Railway Company is gradually going into the hands of investors; 600 shares were recently taken by the Society of Jesus, of Montreal; 300 by Mr. John Breaken, Quebec, besides several other smaller lots. Mr. James Ross is now the largest individual shareholder in the company, having no less than 6,000 shares to his name, representing over half a million dollars at present market prices.

Duncan McDonald has been appointed Superintendent of the Montreal Street Railway. Mr. McDonald has for some time been acting superintendent, and the appointment is looked upon as a popular one.

Several capitalists of Collingwood are, it is said, discussing the advisability of forming a company for the purpose of building electric tramways on several of Collingwood's streets.

The Hamilton, Grimsby and Beamsville Electric Railway Company's shareholders have passed a resolution limiting to $100,000 the stock to be placed upon the market, and the directors have been authorized to float bonds sufficient to complete the road to Beamsville. Stock in the concern is being freely taken up.

A scheme to connect Aylmer and Hull, seven miles distant, by electric railway, has recently been laid before the Aylmer town council by a private company with a capital of a quarter of a million dollars, represented by Mr. T. Viau, contractor of Hull and promoter of the Hull company. Montreal and Quebec capitalists are backing Mr. Viau. They propose to build a line connecting Aylmer with Hull, which practically means connection with Ottawa as well, and give Aylmer an electric light system upon the condition that the ratepayers of that town bonus the company $10,000 and grant them thirty five years exemption from taxes. The council now have the matter under consideration.

General News.

What is Going on in the Electrical World.

Golden City, Mo.—Among other improvements contemplated here an electric light plant is being considered.

Wheeling, W. Va.—The Wheeling Electrical Company is putting in a fine lot of new machinery of the Westinghouse make.

Toronto, Can.—As the result of a deal the Toronto and Scarboro Electric Railway has been transferred to the Toronto Railway Company.

Hull, Mass.—The town has purchased the plant and franchise of the Hull Electric Light Company and taken possession of the property.

South Orange, N. J.—The South Orange and Maplewood Electric Company has been granted a franchise for a trolley line between South Orange and Orange.

Colorado Springs, Col.—The officials of the Denver and Rio Grande Railroad are considering a proposition to change the branch line to Manitou into an electric line.

Waco, Texas.—The Waco Gas Company, to whom the contract for the electric lighting of the city has been awarded, will erect a new plant at once at a cost of $50,000.

Portland, Ore.—A scheme under consideration here is the building of an electric railway up the Tualatin and through the Upper Nehalem to Vernonia and the coal fields.

St. Louis.—The St. Louis and Suburban line has equipped several of its cars with the new illuminated street car sign, showing the route of the cars by an arrangement on the roof.

Providence, R. I.—The Cable Railway Company has been granted permission to use the overhead trolley system in the operation of its cars over Angell and Waterman streets.

Homestead, Pa.—The Homestead Electric Light and Power Company has ordered a new outfit of machinery and new arc lights, and the latter will be placed throughout the town.

Buffalo, N. Y.—The Niagara Falls Power Company has applied to the board of aldermen for permission to string wires in Buffalo for distributing the electric power from the Falls.

Ogdensburg, N. Y.--The street railway here is to be rebuilt, equipped as a trolley road and extended. The change is to be made in time to have the new system in operation by the 1st of June next.

Port Huron, Mich.—The council has decided to present to the voters at the coming election a proposition to bond the city for $40,000 for the purchase and building of an electric light plant.

Bryan, Ohio.—The Bryan Electric Company intend to greatly enlarge their plant next spring. A recent change was made in the affairs of the company by which Frank Conrad becomes secretary and treasurer.

Harrisburg, Pa.—The Harrisburg Foundry and Machine Works lately shipped eleven car loads of machinery for the complete engine equipment of an electric power and light plant at Trinidad, West Indies.

Skowhegan, Me.—The opening of the electric road from Skowhegan to Norridgewock last week was celebrated by a balloon ascension, canoe and boat race, firemen's contest and other popular diversions.

Vancouver, B. C.--The experiment of running a municipal electric plant in New Westminster, B. C., has proved so successful that the people of Vancouver also have decided to equip their city with a plant of its own.

Ithaca, N. Y.—A new instructorship in electrical engineering has been established at Cornell University, and Irwin J. Macomber, instructor in experimental engineering, has been transferred to the new place.

DeLand, Fla.—It is reported here that the contract has been let for the building of an electric road for freight and passengers, the route being from DeLeon Springs through West De Land, Beresford and DeLand to Orange City.

Oskaloosa, Ia—A receiver has been appointed for the Oskaloosa Edison Light and Power and Land Company. Interest was defaulted on $50,000 bonds for two years. The General Electric Company are owners of $7,500 of these bonds.

Lynchburg, Va.—The city council has passed an ordinance appropriating $60,000 for an electric light plant, but discussion has arisen as to the financial ability of the city to increase the expenditures without exceeding the bond limit.

Appleton, Wis.—A franchise has been granted to the Inter-Urban Railway Company for a route through this city for their proposed electric railway which is to connect all the Fox River Valley towns from Oshkosh to Kawkawna.

Hamilton, Can.--It is announced authoritatively that the money to build the projected radial electric railway from Hamilton to Guelph via Watertown has been subscribed by a syndicate of Boston capitalists with W. F. Forsyth at its head.

Springfield, Mo.—Owing to the exacting provisions of the specifications drawn up by the city attorney, no bids were offered in response to the recent advertisement for proposals for electrically lighting this city. The specifications will probably be modified.

Chillicothe, Mo.—The waterworks and electric light plant will be sold at auction here on December 6 by Van R. Caldwell, special commissioner and master in chancery. The bonded indebtedness amounts to about $250,000 with considerable accrued interest.

New York.—Work has been begun on the electric road which is to run from Lexington avenue and the Harlem River through 116th street, Manhattan avenue and 109th street to Columbus avenue. The cars will be operated by an underground trolley system.

Detroit, Mich.—The common council has confirmed the lighting commission's contract for the purchase of lighting towers from the Peninsular Electric Company. It is more than a year since the agreement for the purchase of the towers was made by the commission.

Huntington, W. Va.—The Imperial Electric Bell and Fire Alarm Company, lately organized here, hold several patents on the articles they intend to manufacture, and they are confident that a large business can be built up which will within a year employ 400 or 500 hands.

Windsor, Conn.—Business at the Eddy Electric Works is much improved. Orders have been increasing for several weeks past and the works are running overtime, sometimes all night. The company is now doing a larger business than it has done at any other time in the past two years.

Marlboro, Mass.—Surveys are to begin immediately for an electric railroad between here and Westboro, to connect this city with the Boston and Albany Railroad at the latter point. The road is capitalized at $100,000, and nearly all of the stock has been taken up. The distance is seven miles.

Bay City, Mich.—Walter S. Eddy, of Saginaw, Warren Y. Soper and Thomas Ahearn, of Ottawa, Ont., are about to form a corporation for the purpose of building an electric road in Saginaw and Bay Counties. They have asked our council for a franchise for a double track electric railway in this city.

Fall River, Mass.—F. S. Stevens, R. T. Davis, Frank Brightman, W. F. Thomas and Benj. Cook have applied to the general court for articles of incorporation as the Fall River and Providence Railway Company for the purpose of building and operating an electric railway between Fall River and Providence.

Dayton, O.—Proposals will be received by the trustees of the Dayton State Hospital until Thursday, November 22, for furnishing and erecting an electric lighting plant at the hospital. Blanks will be furnished by the trustees, and all legal formalities must be complied with to secure consideration of the proposals.

Elyria, O.—The county commissioners have granted a franchise for an electric railway running through the county from the Cuyahoga county line and designed to connect this city and Cleveland. The road will be finished next summer, and will be twenty-three miles long. It will be built by the Berea Electric Company.

New Orleans.—President Littell, who is at the head of our electric street railway system, has fitted up a room at the office on Canal street, which will be provided with comfortable furniture and all the latest reading matter relating to street railways and also current literature for the use of the employes on the street car lines.

Maumee, Ohio.—The opening of the electric road in Maumee is to be marked with unusual festivities, among them an old-fashioned barbecue. A young steer is now being fattened on Mayor Keeler's farm for the occasion. The first trip will be for the benefit of some Maumee church and $1 is to be charged for the round trip.

Palatka, Fla.—The town council has granted a franchise to the Electric Light and Supply Company to put in a plant here, and the company say they will have their wires strung and their plant in by January 1. The Gas Light Company strongly opposed the granting of the franchise and has now made arrangements to put in electric lights itself.

St. John, N. B.—Yarmouth and Boston capitalists have organized a company for the purpose of constructing an electric railway from Yarmouth to Amherst, Nova Scotia, and thence to St. John. The company intends to utilize the tides of the Bay of Fundy, whose rise and fall are between thirty and forty feet, in generating electrical power.

Pittsfield, Mass.—A new electrical company with a capitalization of $125,000 has been organized here under the firm name of the S. K. C. Specialty Company for the manufacture of small motors and minor electrical machinery. The company will work somewhat in connection with the Stanley Electric Works, taking such contracts as would incommode the latter.

Cape May, N. J.—Superintendent James E. Taylor, of the Franklin Electric Light Company, who is also general manager of the South Jersey Railroad, announces that work will be commenced immediately on a $50,000 plant which is to supply incandescent as well as arc lights. In the company are Logan M. Bullitt and Thomas Robb, of Philadelphia; Mayor Hildreth and ex-Mayor F. J. Melvin.

Boston, Mass.—The railroad commissioners were overrun with inventors of car fenders a few days ago at a hearing they gave for the purpose of getting all possible information on the subject, with a view of selecting a fender for the street cars that would be a certain life-saver. The size of the gathering was such, and the models and designs so numerous, that the commissioners decided to postpone action until November 16.

Norristown, Pa.—It is expected that the electric road from Norristown to Philadelphia will be completed before Christmas.—The Philadelphia and Rosemont Electric Railway Company is acquiring a right of way from Philadelphia to Bridgeport via Bryn Mawr, Ardmore and Gulf Mills and other villages in Upper Merion. The company desires a franchise over certain streets in Bridgeport, and the matter is in the hands of a committee of council.

Joliet, Ill.—It is understood that several Baltimore capitalists acting in conjunction with A. J. Green, of Windsor, Ont., intend to purchase the properties of the Joliet Street Railway Company, the Economy Light and Power Company and the Joliet Gas Works Company, and the probabilities are that the electric street car system will be extended from Lockport to Chicago. The Joliet system will be overhauled at a cost of $60,000. The electric light and gas plants will both be enlarged.

Quebec, Can.—The Hon. L. P. Pelletier, Senator Landry, Mr. Fremont, M. P., P. B. Dumoulin, cashier of the Quebec branch of the Banque du Peuple, Ald. Leonard and Messrs. J. U. Gregory and Ernest Pacaud intend to ask the Legislature next session to incorporate them as the Quebec City and District Railway Company with power to build and run electric railways in the city of Quebec, and also in the counties of Quebec, Portneuf, Montmorency, Levis, Bellechasse, Dorchester, Beauce and Lotbiniere.

Philadelphia.—At a meeting here of the capitalists interested in the projected electric railway between New York and Philadelphia, it was asserted that all of the necessary rights of way for the main line and branches have been secured, and sufficient money has been subscribed and paid in to warrant the immediate construction of the road. The surveyors have already finished the larger part of their labors. The road will be built in sections, and will be equipped and operated as rapidly as constructed. Besides passengers, the company expects to carry express, mail and freight.

Findlay, O.—An electric railway between Findlay and Toledo is projected, the leading spirit in the enterprise being George B. Kerper, of Cincinnati, who is president of the Findlay Street Railway Company and the Hancock Electric Light Company of this city. The new line is to parallel the Toledo and Ohio Central road from Findlay to Bowling Green. From that point it will connect with the road to be built to Perrysburg by E. H. McKnight and others, and from Perrysburg will connect with Toledo by the Foster Electric Railway. The right of way is now being secured, the conditions being that the road shall be completed by November, 1896.

Kansas City, Mo.—The Missouri District Telegraph Company, a local organization, has purchased all the city lines of the Western Union in Kansas City and vicinity and will handle all that company's local business, operating on a system the same as the metropolitan department of the Western Union in Chicago and New York. The capital stock of the new company is $50,000. Col. L. C. Baker, of St. Louis, a Western Union superintendent, is the president; R. H. Bohle, the Western Union's St. Louis manager, is treasurer; M. D. Wood, the Kansas City manager, is the superintendent, and J. W. Murphy, an old employe of the Western Union, is the manager of the new enterprise.

Chicago.—The Chicago Rapid Transit Company have asked the public service committee of the county board for a franchise authorizing the construction of an electric railway in the northwestern boundaries of the city.—A project is afoot here to build an overhead electric trolley street railway line into the heart of the city. The plan is said to be to secure right of way and a franchise to build a road with a loop on South Water, Rush, River and Michigan streets, thence north on Rush to Indiana, west to Union, north to Ohio, west to May, north to Huron and northwest to Norwood Park.—"A scheme, bold, novel and magnificent, to remedy the evil of a multiplicity of surface and elevated railroads in the business district of this city," says the *Dispatch*, "has been under serious consideration for the past two years. Engineers have been in consultation, scientists have been studying and planning, and capitalists have been quietly organizing for one of the greatest intramural systems of railways ever devised by the mind of man. The plan as already formulated contemplates a grand system of underground electric railways which will connect with every railway and railroad depot in the city. The scheme is a bold one, but those who have investigated it pronounce it perfectly feasible. The idea is to excavate under all the principal streets between 12th street and Kenzie avenue, and between the lake and Canal street. In all, it is calculated that about twelve miles of underground railroad will be necessary. This, it is estimated, will cost about $1.000,000 a mile, or about $12,000,000 in all. That amount of capital has already been pledged by capitalists in Chicago, New York and Boston, who stand ready to furnish the money as soon as the plans are formulated and the necessary franchise obtained."

The Watervliet Arsenal Plant.

Success of the E. G. Bernard Company.

Following close upon the decision of Judge Acheson declaring the Edison feeder and main patent void, Judge Coxe of this State has raised the injunction obtained by the G. E. Company against the electric plant at the Watervliet Arsenal, Troy, N. Y., installed by the E. G. Bernard Company some time ago, and the plant was started last week.

As erected in the arsenal there are two complete plants, situated about a quarter of a mile apart and connected in such a manner that either can furnish the required current to operate the lighting or power circuits in the grounds, shops or other buildings. Plant No. 1 is situated in the engine room of the new gun shop, and consists of two 100 kilowatt generators, equal to 135 horse-power each. Plant No. 2 is located in the lower or old shop, and consists of two 50 kilowatt generators, equal to about 67 horse-power each. Attached to each plant is a motor generator, used as an equalizer, which permits the Government to use any one of its generators, which comprises 110 volts and 220 volts current at the same time. The 110 volt current is used for illuminating purposes and the 220 volt for power. In order to obtain the same results with any other system two separate machines would have to be employed. This latter complication would hinder matters, especially in case of trouble with one of the dynamos, and might also cause a complete stoppage of the works in case of war.

Mr. Bernard, of the E. G. Bernard Company, designed two new switchboards for this plant which allow every wire and connection to be in sight of the person operating the same, giving every possible combination of connections on the several circuits, and insuring against any possible breakage. He also designed and laid out the whole special system of wiring, etc. The entire system is valued at $30.000 and is perfect in every detail. This includes the expense of the removal of the Edison and Thomson-Houston apparatus by the E. G. Bernard Company.

Fifty-three lights are situated in different parts of the grounds. The gun shop is lighted with over 800 lamps, the smaller shops having over 300 lights, while the officers' quarters are illuminated with about 350 lamps. The soldiers' quarters, barracks and offices are supplied with 200 lamps, while scattered about the grounds are 100 more. Power is furnished to run the 75-ton, 30-ton and 150-ton cranes in the new gun shop, which cranes have from one to four motors each.

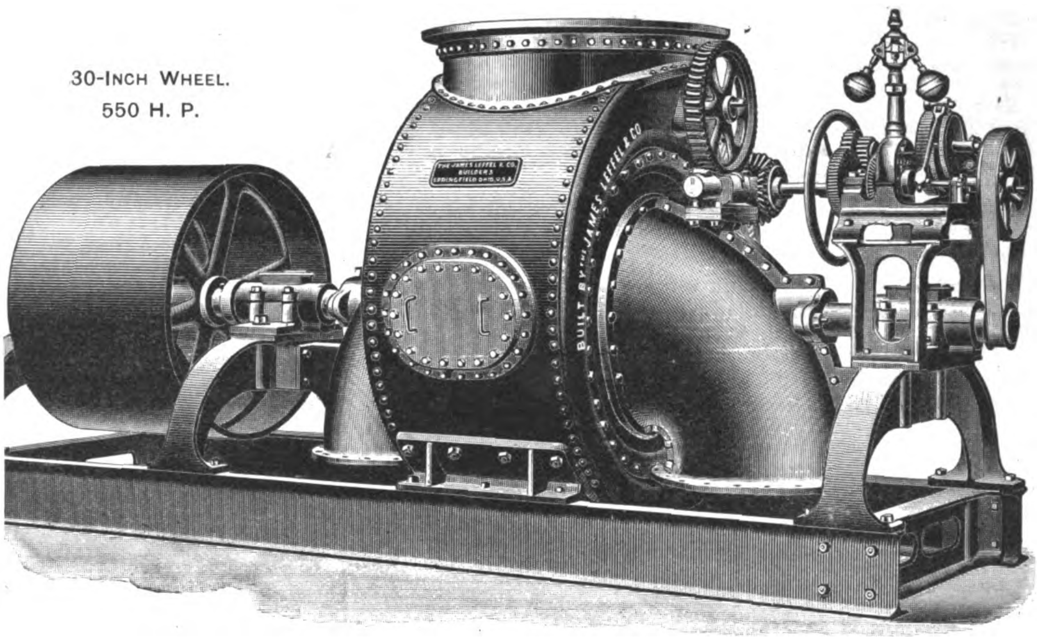
The Bernard Company reports a revival of business and is about two weeks behind on its orders. The company has just finished equipping the residences of Levi P. Morton and John Jacob Astor at Rhinecliffe with electrical apparatus. It is also shipping a complete plant to Lord & Taylor for their Broadway store. Contracts have been closed with Huyck & Sons of Albany, Ormsley Textile Company of Waterford, and William Yeardon of Fort Plain, and two machines are to go to a large apartment house in Chicago.

New Double Discharge Turbine.

The illustration herewith represents a very unique and pretty design of a new type of Turbine Wheel on a horizontal shaft. It is simple in form and capable of easy and very substantial construction. This illustration is an exact reproduction from a photograph of a wheel in actual practice, driving a portion of a large electric plant where several others of the same design and style are in use, under a working head pressure of 90 feet.

It will be seen that the water enters vertically on the top. The design, however, admits of receiving the water at any inclination from a vertical to a horizontal line. When it enters the outer casing in which is placed the guide casing of the wheel or runner, the water completely surrounds the guide casing, under whatever head pressure the wheel is placed, and is admitted to the circumference of the runner or wheel proper through the guides, leaving the wheel after doing its work.

The runner itself is a double wheel, receiving the water from a single set of guides which surround the circumference of the runner. The wheel is so constructed as to divide the water into two equal portions on receiving it from the guides; these equal portions each operate upon the wheel, which discharges the water horizontally in opposite directions on the performance of its work.


30-INCH WHEEL.
550 H. P.
THE JAMES LEFFEL & CO.
BUILDERS
SPRINGFIELD OHIO, U.S.A.
BUILT BY JAMES LEFFEL & CO

NEW DOUBLE DISCHARGE JAMES LEFFEL TURBINE.

The water then passes through the curved tubes on each side of the wheel and discharges into the tail water below. This method of application of water to a turbine entirely avoids end thrusts or end pressure of the shaft; in other words, it prevents the water from getting between the wheel and any part of the casing, avoiding loss of power therefrom. The wheel is thereby relieved from excessive friction, a source of loss that often occurs in various styles of turbines. The wheel illustrated is 30 inches in diameter and of 550 H. P. capacity. Its regulation is nicely secured automatically by means of a governor, shown in the cut. This regulation, so successfully obtained, is peculiar to the form, design and construction of the wheel, rendering it thereby highly efficient as a motor for electric light, electric power and various purposes for which a large number of the same design may be seen in daily practical operation. The same parties using the wheel illustrated recently applied another of the same pattern of 400 H. P., having a diameter of 26 inches.

The wheel shown herewith has a pulley of 42 inches face, 48 inches diameter, transmitting the whole power through a 40-inch belt to the electrical machinery. The design is essentially the same as that of the two turbines, each 1,200 H. P., built for the Cliff Company at Niagara Falls, except that in those wheels neither pulleys nor governors are used, the power being applied directly to the machinery at each end of the water wheel shaft on each side of the turbine.

Three pairs of a modification of the type of wheel illustrated were recently supplied to an electrical plant in Mexico, each pair being 20 inches in diameter and of 600

H. P., nearly 1,800 aggregate H. P. The transmission in this instance was 18 miles. Further particulars concerning the details of turbines of this type may be obtained by addressing James Leffel & Co, Springfield, Ohio, who make a specialty of this design and line of work.

The Holzer-Cabot Company in New York.

The Holzer-Cabot Electric Company of Boston, who opened a New York branch several months ago in charge of Mr. David Chalmers, have no reason to regret their venture. They have done a good business here from the start, especially in the smaller sizes of Generators, for which the company is best known.

They are carrying in their store-room at 114 Liberty street a full line of supplies of their own manufacture, in addition to several choice specialties. Catalogue will be sent upon application.

Ft. Wayne Apparatus in the Northwest.

The following are recorded among the recent sales by the Northwest office of the Ft. Wayne Electric Corporation:

The village plant at Springfield, Minn., consisting of two 35-light Wood arc machines to be driven by Hicks's gasoline engines; city plant at Marshall, Minn., consisting of a 750-light alternator and 35-light arc, both "Wood" machines, and to the lighting plant at Waupaca, Wis., a 1,500-light alternator, replacing their present Brush direct current system.

The Horn & Brannen Mfg. Company.

The name of the old firm of Horn, Brannen & Forsyth has been changed to the Horn & Brannen Mfg. Company. There is no change, however, in the quality of the goods made by the concern, or in their policy, which has always been to keep at the head of the procession in everything pertaining to Fixtures for gas or electric lighting or both. Mr. James Brannen, the courteous manager, is not a believer in combinations and has persistently steered his company clear of the many trades and deals which have wrecked so many of the once prosperous concerns in the fixture trade. The Horn & Brannen Mfg. Company is worthy of full confidence, and if they are not carrying the Fixtures you need in stock, they have several artists who make special designs to order.

COMMERCIAL PARAGRAPHS.

The Jonson Engineering and Foundry Company of New York are making a specialty of Dynamo Changing Switches of any capacity required. They also make Fuse Blocks, Short-Circuiting Blocks, Double-Pole Jaw Switches, Special Brass and Copper Work, and repairs.

The Mather Electric Company, Manchester, Conn., is now running until 9 o'clock at night with a force of 61 hands, and orders ahead.

The Improved Stopper Lamps of the Beacon Company of Boston are growing in favor in this city, where more of them are said to be in use than at any time since they were put on the market.

Messrs. Morris, Tasker & Co., of Philadelphia, had good fortune at Atlanta in making their specialties better known to the street railway men of the country.

The Hawkeye Harrison Telephone Company, which owns the privileges of the Harrison Telephone for Iowa, has agents in Sioux City making arrangements to put in a new exchange to compete with the Bell.

The Paragon Insulating Company of Cleveland, O., are in the market with the Acme Insulating Paint, for which strong claims are made. Messrs E. P. Roberts & Co. have made an elaborate test of this paint and report it equal to the best.

The latest catalogue of the H. W. Johns Company is a work of art, showing dozens of the finest buildings in the country where the products of the company are in use.

The Michigan Electric Company of Detroit are now well under way and doing a very nice local business in small supplies. They have several agencies, including that of the Siemens & Halske Company and the P. & P. Company, for the State of Michigan, and should get a good share of the business in this territory.

The Partridge Carbon Company of Sandusky are doing a constantly increasing business in their specialty of Motor Brushes, which are of a quality never excelled in this country.

One of the most convenient fixtures ever placed on the market for desk lighting is offered by the Faries Mfg. Company of Decatur, Ill.

The United Electric Improvement Company announce that they are finally installed in their new quarters, Warden Power Building, 19th street and Allegheny avenue, Philadelphia.

INCORPORATIONS.

Terre Haute and Brazil Electric Railway Company, Terre Haute, Ind.—to operate an electric railway. Capital stock, $16 000. Promoters: Max Joseph, C. F. Miller, J. G. Elder, Terre Haute.

The Chicago Central Electric Railroad Company, Chicago, Ill.—to construct and operate, by steam or electric power, street, horse, dummy railroads and tramways. Capital stock, $1,200,000. Promoters: George W. Waterman, Wm. R. Odell, Chas. A. Boos.

The Ohio Electric Gas Company, Springfield, Ill.—to manufacture, own and sell machines for the purpose of generating gas for illuminating and heating purposes; acquire patents or gas machines. Capital stock, $250,000. Promoters: H. Clay Wilson, Jno. G. Friedmeyer, Benj. Knudson.

The Pacific Electric Company, Pacific, Mo.—to operate a light and power plant. Capital stock, $5,020. Promoters: A. H. Brown, A. Kappitz, G. H. Gross, Pacific, Mo.

The Gold Blossom Gold Mining Company, San Francisco, Cal.—to deal in and operate mines, machinery, furnaces, reduction works, concentrators, water rights and water works, electric light and power works. Capital stock, $20,000. Promoters: Chas. F. Reed, Auburn; F.A. Berlin, Emile Besson, San Francisco.

The Lake George Improvement Company—to construct and maintain a line or lines of telephone from the head of Lake George, in the town of Caldwell, N. Y., to connect the village of Lake George and Bolton Landing. Capital stock, $1,000. Directors: E. R. Ziebech, C. R. Mott, of Lake George; George Tanner, of Bolton Landing, and others.

The Franklin Illuminating Company—to furnish electric light for Sea Cliff and Glen Cove, L. I. President, Dwight W. Pardee, Brooklyn; secretary, Frank J. Cole, of Sea Cliff; treasurer, John Graham, of Sea Cliff; board of managers, Samuel Stenson, W. A. Porter, F. D. White and D. W. Pardee, of Brooklyn, and John Graham, of Sea Cliff.

Mutual Gas and Electric Company, of Brooklyn, N. Y.—to manufacture and supply gas for street lighting, etc., and to manufacture electricity for producing light, heat and power. Capital stock, $100,000. Directors: Aquila W. Wanmaker, of Jersey City, N. J.; Thomas Patterson, of Brooklyn, and Charles H. Selig, of New York City.

The Spearfish Electric Light and Power Company has filed articles of incorporation at Pierre, S. Dak. Capital stock, $50,000. Incorporators: W. S. Corbin, J. M. Cameron and J. A. Griffin, all of Chicago.

The Polar Star Electric Company, Faribault, Minn.—to manufacture, generate and transmit electricity for light, heat and power. Capital stock, $50,000. Promoters: Jas. Hunter, Rob't G. Weatherstone, Jas. F. Hughes, Faribault, Minn.

The Marks-Ayer Electric Company, Plainfield, N. J.—to generate, sell, transmit and supply electricity for the purpose of furnishing light, heat and power, etc. Capital stock, $350,000. Promoters: Louis J. Marks, New York, N. Y.; Jas. I. Ayer, Harry G. Runkle, Plainfield, N. J.

The Taylor Belding Electric Company, Chicago, Ill., has certified to change of name to Pioneer Electrical Manufacturing Company, and a reduction of capital stock to $6,000.

The Cambridge Electric Light Company, Cambridge, Ill. Capital stock, $12 000. Incorporators: D. D. Lamb, Henry White and others.

The F. P. Electric Company, at Chicago. Capital stock, $500,000. Incorporators: Edward I. Frost, Charles W. McCorkle and E. W. Cramer.

The Pennock Electric Light and Power Company, Limited, Detroit, Mich.—to manufacture, rent and sell electrical apparatus, machinery, etc., and engage in lighting, plating, running electric motors, cars and railways for freight and passenger service, telephone and telegraph business, etc. Capital stock, $1,000,000. The officers for the first year are Frank B. Richmond, chairman; W. R. King, secretary; Llewellyn Gibson, treasurer. The officers are the principal stockholders.

Home Telephone Company, Crawfordsville, Ind. Capital stock, $15,000. A. F. Ramsey is one of the directors.

The Eclipse Electrical Company, St. Louis, Mo.—to manufacture electrical appliances. Capital stook, $9,000. Promoters: Chas. E. Smith, Isidor Fajans, E. C. H. Foelkers, all of St. Louis.

The Magnetic Telephone Company, Oak Park, Ill.—to manufacture, sell and lease telephones, electric appliances and machinery. Capital stock, $100,000. Promoters: Henry E. Procuiner, Geo. W. Wilson, David J. Kennedy.

The Harrison Telephone Company at Lincoln, Neb., has filed articles of incorporation. It is to operate in Nebraska and States west of the Mississippi River, with a capital stock of $200,000. Lincoln is to be headquarters. The incorporators are George D. Sheibley, A. E. Hargreaves, S. H. Burnham, J. E. Hill, F. B. Righter and C. E. Magoon.

The United States Telephone Company, Chicago, Ill.—to construct, operate and maintain electric telephones and telegraph exchanges; construct and maintain trunk lines for electrical telephone and telegraph purposes; deal in and manufacture electric supplies of all kinds that pertain to its business. Capital stock, $75,000. Promoters: Henry S. Perkins, Elias D. Greenlee, Nelson G. Franklin.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED OCTOBER 23, 1894.

ELECTRIC RAILROADS AND APPLIANCES.

527,840 Support for Trolley-Wires. Frederick C. Fisk, Buffalo, N. Y. Filed March 1, 1894.

527,857. Transformer System for Electric Railways. Maurice Hutin and Maurice Leblanc, Paris, France, assignors to the Societe Anonyme pour la Transmission de la Force par l'Electricite, same place. Filed Nov. 16, 1892.

527,873. Closed-Conduit Electric Railway. James F. McLaughlin, Philadelphia, Pa. Filed April 5, 1894.

527,874. Closed-Conduit Electric Railway. James F. McLaughlin, Philadelphia, Pa. Filed May 24, 1894.

527,920. Trolley-Wire Support. Montraville M. Wood, Chicago, Ill., assignor to the Wallace Electric Company, same place. Filed April 30, 1894.

527,927. Electric Motor for Railway-Cars. Norman C. Bassett, Lynn, assignor to the General Electric Company, Boston, Mass. Filed June 28, 1893.

527,947. Method of and Means for Controlling Electric Cars. Harry P. Davis, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, same place. Filed March 29, 1894.

527,990. Electric and Gravity Pleasure Railway. Charles A. Idler, Atlantic City, N. J. Filed June 26, 1894.

528,101. Trolley-Wire Switch Plate. Gustavus A. Huben, Springfield, Ohio. Filed Feb. 23, 1894.

ELECTRIC LIGHTS AND APPLIANCES.

527,826. Carbon for Electric Lights. Edward G. Acheson, Monongahela City, Pa. Filed Aug. 25, 1894.

527,864. Carbon-Holder for Arc Lamps. Erwin Lavens, Brooklyn, assignor to the General Incandescent Arc Light Company, New York. Filed March 17, 1894.

527,901. Electric-Arc Lamp. Hans O. Swoboda, New York, N. Y., assignor to the General Incandescent Arc Light Company, of New York. Filed March 2, 1894.

527,989. Combined Regulating Incandescent Lamp and Socket. Charles A. Hussey, New York, N. Y. Filed May 14, 1894.

528,021. Electric-Lighting System. George J. Parfitt and George J. T. J. Parfitt, Keynsham, England. Filed July 12, 1892.

528,119. Electric Arc Lamp. Sigmund Bergmann, New York, N. Y. Filed April 6, 1894.

MOTORS, DYNAMOS, ETC.

527,766. Metal Brush for Dynamos. Wilhelm vom Braucke, Thimerterbach, near Westig, Germany. Filed July 2, 1894.

527,776. Electric Motor or Dynamo. Cornelius F. Daniels, Macon, Ga. Filed Dec. 2, 1891.

528,121. Alternating-Current Motor. Charles T. Child, Ashland, Va., assignor to the Electric Power Company of Maine. Filed Dec. 22, 1893.

TELEPHONE AND TELEGRAPH APPARATUS.

528,040. Telephone Circuit and Signal. Theodore Spencer, Cambridge, assignor to the American Bell Telephone Company, Boston, Mass. Filed Nov. 18, 1893.

528,075. Combined Telephonic and Signaling System. Henry A. Chase, Boston, Mass., assignor to Albert Watts, same place. Filed June 25, 1893.

BATTERIES.

527,861. Method of Manufacturing Elements or Plates for Secondary Batteries. Hugh F. Kirkpatrick-Picard and Henry Thame, London, England. Filed Jan. 10, 1894.

SIGNALS AND SIGNALING APPARATUS.

527,839. Annunciator-Signal. Isaiah H. Farnham, Wellesley, Mass., assignor, by mesne assignments, to the Western Electric Company of Illinois. Filed Feb. 23, 1894.

527,958. Electrical Signaling System. Bradley A. Fiske, U. S. Navy. Filed May 13, 1892. Renewed Sept. 15, 1894.

528,122. Auxiliary Signaling System for Railways. Mahlon S. Conly, Chicago, Ill., assignor to the United States Electric Railway Signal Company, New York, N. Y. Filed March 6, 1890.

528,127. Circuit Changer for Electric Signaling Systems. John F. Hunter and Samuel H. Lough, Seattle, Wash. Filed Sept. 3, 1892.

MISCELLANEOUS.

527,786. Self-Winding Electric Clock. Emil G. Hammer, Brooklyn, N. Y. Filed July 18, 1893.

527,788. Electric Uterine Battery. Charles E. Hebard, Grand Rapids, Mich., assignor of one-fourth to Hanford C. Keith, Rhinelander, Wis. Filed July 11, 1894.

527,827. Machine for Black-Leading Electrotype Matrices. Oliver B. Beach, Stony Creek, Conn. Filed Aug. 23, 1893.

527,830. Process of Treating Lead Hydrate Produced by Electrolysis. Arthur B. Browne, Cambridge, Mass., assignor to the American Lead Company, Kittery, Me. Filed Jan. 10, 1894.

527,847. Process of Reducing Aluminium. Frank A. Gooch, New Haven, and Leonard Waldo, Bridgeport, Conn.; said Waldo assignor to the Waldo Foundry of New Jersey. Filed April 25, 1894.

527,886. Coin-Controlled Machine. Isaac Richardson, Cleveland, Ohio. Filed Jan. 22, 1894.

527,922. Electric Belt. Jonas Backstrom and Frank W. Johnson, Stromsburg, Neb. Filed April 17, 1894.

527,977. Automatic Electrical Boot-Blacking Machine. John O. Heinze, Jr., Lynn, Mass. Filed April 2, 1894.

528,014. Electric Switch. James F. McLaughlin, Philadelphia, Pa., assignor to James W. Difenderfer, same place, and Theodore H. Gehly, York, Pa. Filed May 6, 1893.

528,042. Cathode for Electrolytic Processes and Method of Making Same. Ernest Stouls, Paris, France. Filed Jan. 12, 1894.

528,053. Magnetic Separating-Machine. William H. Williams, Newark, N. J. Filed June 27, 1891.

528,054. Magnetic Separator. William H. Williams, Newark, N. J. Filed Jan. 29, 1892.

528,055. Magnetic Separator. William H. Williams, Newark, N. J. Filed Jan. 29, 1892.

DESIGN.

23,743. Frame for Dynamos. Clinton E. Woods, Chicago, Ill. Filed June 11, 1894. Term of patent 14 years.

ELECTRICITY.

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Copies of "Atlanta—A Retrospect," printed on artists' proof paper, with wide margins, for framing, sent to any address postpaid on receipt of 50 cents in stamps.

EDITORIAL NOTES.

Popular Electrical Science. With this issue we begin a series of articles on Popular Electrical Science which, we feel assured, will meet a long-felt want in the constituency usually reached by the electrical papers. In fact, after a very careful survey of the whole field, we are convinced that this department will create a new constituency of vastly wider proportions than that to which electrical papers have heretofore catered. That existing electrical journals do not meet the public demand has become the subject of such general remark among those whose business it is to feel the public pulse from the newspaper and literary standpoint as to put it beyond question. In explanation of this failure the paradoxical statement is made that the electrical papers fall short of the mark by shooting over it. Electrical articles to be understood by the majority of the intelligent reading public must needs be couched in simple terms. To command the respect and confidence of these same classes they must perforce be technically accurate. To excite interest they must be on interesting subjects. While there is a place for the more technical articles and a constituency that will read them, it is our conviction that the place for them is not in ELECTRICITY, and that that constituency is necessarily limited to the comparatively few specialists who look rather to the transactions of the American Institute of Electrical Engineers and allied foreign societies for their pabulum than to the weekly journals. We believe that our electrical contemporaries—excellent in their way as most of them are—have fallen far short of the ideal, in that they have neglected the masses and catered only to the select few. They have unconsciously stood in their own light in following out this policy, for the mass of the material printed by them from week to week, extremely valuable though it be, is not read—cannot be understandingly read—by the average business man for whose benefit it is presumably prepared. The result is that neither advertiser nor purchaser derives benefit from the reading columns, and the paper is laid aside without perusal.

There are some who maintain that the printing of purely technical articles is necessary to the dignity of the sheet, and that the amount of such matter used is a gauge of that dignity. With those who thus argue we must beg leave to dissent.

It is a comparatively simple thing to describe an apparatus or a phenomenon in technical terms, so that it will be readily understood by technical men well versed in the technology used, but it is a high art to describe those same things to a man not versed in that technology so that he will obtain a clear and correct comprehension of the same. Surely the writer or lecturer who can convey his information to his audience in language which they can understand does not sacrifice his dignity in so doing, nor will a journal that successfully interprets the language of the scientist into that which the world can understand be accorded a less honorable position in journalism than those which parrot-like merely transcribe the language of the investigator.

Appreciating all this, we take the first step towards occupying the field we have indicated, by a series of articles from the familiar pen of Mr. Nelson W. Perry, E. M., the initial number of which appears in this issue. This series will comprise a very long list of subjects of interest as well to the electrician as to the layman. The descriptions will be given with Mr. Perry's usual attention to technical accuracy, and couched in terms which the least technical can understand. We bespeak for this series the close attention of the reading public.

* * *

THE LAST prop will be removed from under the G. E. conglomeration when the United States Supreme Court decides this month that the lamp patent is, like Coffin, *ausgespielt.*

* * *

ELECTRICITY expects to live long enough to furnish a sympathetic report of the obsequies over the remains of the G. E. Company.

The Encouragement of Charlatanry.

We have many times animadverted in these columns upon the disreputable tacit endorsement of charlatanry to be found in the advertising columns of the daily press and of our periodical journals. In fact it seems that this perverse and immoral practice has permeated almost every branch of journalism, and it is with shame that we are forced to admit that the columns of all classes of periodicals are purchasable for gold for the advertisements of those human vultures who fatten upon the credulity and necessities of the sick, the infirm and the unfortunate. We cannot forget those ringing words of Prof. Elihu Thomson, with which he administered a well-merited rebuke to the authorities of the World's Fair, by whose permission electrical quackery was given honorable position in the Electricity Building, side by side with reputable and scientific apparatus. We have quoted Prof. Thomson's words before, but they will bear repetition. They were as follows: "The one discordant note in all this great display of genuine scientific and engineering work was found in the fact that in this same temple of science—in Electricity Building itself—naked imposture, quackery in the form of so-called electric belts, hairbrushes, insoles and what not, had obtained a footing and stalked forth unabashed. No words of condemnation can be too strong to be applied to the parasites who, in the guise of healing and benefaction, succeed in extracting perhaps the last money from the sick and suffering for their worthless trumpery." But bad as this was, and disgraceful as it was to those who were responsible for it, how much worse and how much more reprehensible is it that otherwise respectable newspapers and magazines should prostitute their columns to the propagation of these iniquitous humbugs.

Strange to say, the religious press is one of the chiefest offenders in this line. Those organs—the organs of the very church, whose province it should be to cater to the moral and spiritual welfare of the people, become *particepes criminium* with the human leeches whose wares they advertise. Perhaps the church cannot be held responsible for the acts of those editors who under the guise of saving souls sell their own souls for gold; but can the church afford to countenance such action on the part of its real or accredited organs? We believe not, and we further believe that it is the duty of every pulpit that has the best interests of its flock at heart to inveigh against a practice which brings within the family circle, under the cloak of religion, this outrage against nature and humanity. In England the sale of electric belts and that sort of things has been decided to be a penal offence, and in one case the vender was sentenced to five years' penal servitude. Is it not a shame that appliances of the same kind are vended in this country within the church porch? Electricity thinks it is, and proposes to help put a stop to it. To this end we will publish in a week or two a list of such denominational and religious papers as come under our notice that pollute their columns with advertisements of this character.

But the religious press is not the only offender. It is the worst, by reason of its high office, but not the only one. Not long since we had occasion to call attention to the fact that a journal of such high excellence as the *Cosmopolitan Magazine* had bartered its honor for gold in the same shameless way. The offence in this case was the publication of the advertisement of "Actina," the so-called magnetic eye-cure—an article so devoid of merit that even the authorities at the World's Fair, who could stand electric belts, withdrew from the charlatan who represented it his pass. And now last, but not least, we find the *Review of Reviews*, than which no periodical in the world stands higher, giving up two pages of its space to the Electrolibration Company's advertisement of the Electropoise. This device is too palpable a fraud to permit us to think, as we should like to think, that it was passed as meritorious by those responsible for the magazine. We hope, for the sake of the good name of magazine literature, that such a fraud will not again be aided and abetted by a repetition of the advertisement in the *Review of Reviews*.

* * *

Economy of Gas for Fuel.

The description given elsewhere of an isolated plant in which the motive power is supplied by a gas engine is suggestive of the economy which may be attained by this method of lighting, and considering the relative saving in the direct combustion of fuel in the engine cylinder over the use of a boiler and its connections, it is a matter of some surprise that the former method of driving has not been more generally introduced than we find it at present.

In the field of isolated lighting, gas engine driving presents several features which make its use vastly preferable to a boiler and steam engine, as aside from the undoubted gain in efficiency of the former we also find its economy is still further emphasized by the fact that it requires no expert attendance, while with a steam plant a competent engineer is essential to its proper care and operation.

It is, of course, impossible to compare the figures in the article mentioned with what can be reached in general practice, as comparatively few places are so advantageously situated as to be within reach of natural gas at the rate of 25 cents per thousand feet, but even with gas at five or six times this rate an isolated plant of small size is far more economical than a steam plant or even a central station service.

There are several factors which lend to this economy. The first cost of the plant is one. Between the steam and gas engine the latter is considerably more expensive, but this difference is more than equalled by the boiler and accessories of the steam plant. Aside from the question of cost, the steam plant requires a far greater space and is open to the objections of dirt and noise, which for a private house or small store makes the gas engine much more desirable.

The cost of attendance is another item in favor of the gas engine. It requires only casual attention, which anyone, however unskilful as a mechanic, can give to it, while no steam plant is safe without the attendance of an engineer.

The cost of fuel is also reduced in a gas engine plant in almost every locality, depending, of course, on the price of gas. But it can also be pointed out that where gas is used direct for illuminating purposes it would be generally found as cheap, if not cheaper, to have electric lighting, using the gas for motive power. The reason for this is that the efficiency of gas used at a burner for lighting is extremely low, while its thermal efficiency in a gas engine reaches 20 per cent. and upward, leaving enough difference between the efficiencies to more than cover the loss of the two transformations between the gas lighting and the electric lighting.

As gas engine driving has been gradually attempted, these facts in regard to its economy are beginning to attract the attention they deserve, and it is almost certain that this method of lighting, as soon as it is more generally understood, will find an extensive application in private house plants.

* * *

What Are Conventions Held For?

It is now something over two weeks since the adjournment of the 1894 Convention of the American Street Railway Association at Atlanta. Electricity has already done full justice to the social side of the affair, and the street railway monthlies have printed verbatim reports of all that took place in the Convention hall, of the papers which were actually read and of those read by title only. The best of all this had of course appeared in the electrical weeklies several days in advance of the monthlies. But now the returns are all in, there has been ample time for reflection, and we rise to ask, What sort of a Convention was it? To answer this question properly, we must first answer another, What are Conventions for?

That the Atlanta trip was a thoroughly enjoyable one there can be no doubt. If conventions are held in order to give a few railroad men and a great many supply men an opportunity for a week's vacation, to provide enjoyment and diversion, to drive away all thoughts of humdrum business, then the Atlanta Convention was a howling success. But was this the notion of the founders of the Railway Association? We think not.

No one will dispute, we think, that the fundamental idea of all these trade associations is that the brightest men in the business shall be brought together to discuss methods and means for advancing the interests of all the members; to present the records of the year's improvements, the results of continued development and experiment; to give all the members the benefits of the work of the leaders; to afford an opportunity once a year for the free interchange of ideas, for friction of mind against mind. To accomplish these results there is only one way, and that is to arrange a programme of short papers on subjects of vital interest, and to bring out on each and every paper a vigorous and pointed discussion.

Measured by these standards, what sort of a Convention was the one at Atlanta? The subjects chosen for the papers and committee reports were all good ones, but there was scarcely ten lines of instructive discussion during the entire proceedings. A great many of the papers were read by title only, the attendance at the sessions was ridiculously small, averaging less than one-tenth of the number who went to Atlanta, and there was little interest shown by the few who did attend. Indeed, the almost unanimous opinion expressed is that the Convention proceedings were a farce. Of course we grant that from the standpoint of the supply men everything was just as it should be.

We shall not attempt to give a reason for this state of affairs—we merely suggest that it is time for the leaders of the Association to think of these things if they would prolong the life and usefulness of this body. That the National Electric Light Association knows how to fulfil its mission better is certain, and we advise our railroad friends to be at Cleveland next February, where they may learn a good deal. They will also have fun incidentally, but it will be found that fun does not take precedence over the deliberations of the Association.

The young blood in the American Street Railway Association should assert itself.

* * *

Electric Conduit Roads. The meeting of the New York Electrical Society last Thursday evening will mark an epoch in the history of that organization. This Society, always possessed of a great potentiality for good, has been recently converting a great deal of that potential energy into the kinetic, and if this policy be continued in the future as it has been in the more recent past the future of the society is assured. The policy of the society as evinced by outward signs has been to treat the living questions of the day from the practical rather than from the theoretical standpoint. In evidence of this, we need only mention a few illustrations. The subject of lighting large areas has always been one of the utmost importance, and never more so than at present. The Electrical Society, therefore, visited Buffalo Bill's Wild West show, where they saw, besides an excellent performance, the successful illumination of the largest area thus far attempted. The question of garbage disposal is one that is always with us. The society took an object lesson from the Wolf disinfecting plant at Riker's Island, which they visited in a body.

The question of electric traction by means of the conduit system is just now attracting wide attention, and Mr. Sachs gave the Society a very intelligent description of what has been done in the past and what might be expected in the future. And the members have shown their appreciation of these efforts in their behalf by a full attendance, and of the latter, Mr. Sachs's paper, by a full and exhaustive discussion of the problems involved, in which many of the very best authorities in this country took part.

But all these things do not *happen*. Things that move along apparently so automatically and smoothly usually have some guiding spirit behind them.

In the case of the New York Electrical Society much of its success is due to its present able management. and to none more so than to its able and enthusiastic secretary, Mr. George H. Guy, through whose untiring efforts the opportunities of the Society have been so largely due.

But coming back more specifically to our subject—conduit roads—the general consensus of opinion among those present at the Thursday evening meeting was that there was no difficulty in constructing a conduit road that would work. Our own belief and contention is that there is scarcely an electrician in the country but will deny that there are any mechanical or electrical difficulties that are insuperable. The mechanical difficulties are greater in the conduit than in the overhead system, but they can be overcome if enough money is spent in the solution. The electrical difficulties are greater in the conduit than overhead, but if the conduit be made large enough, and the voltage be made low enough (which means of course more copper), these difficulties also may be overcome; so the question resolves itself in all directions into one of money. There is probably scarcely a practising electrical engineer in the country who if asked if it were possible to construct an operative electric road upon the conduit plan that would not answer unhesitatingly "yes." Why then has not this method become more popular? Simply because it is in competition with a better method. There is but one single feature of the conduit that recommends it above the overhead trolley and that is one that appeals to the æsthetic side of our natures alone. In all other particulars the overhead system stands *facile princeps*. It is cheaper to construct; it is simpler, both mechanically and electrically; it gives better service and, more important for its survival than anything else, it is a better dividend-payer. What incentive, therefore, is there to capital to an investment of half a dozen or more times the money for something which in its ideal perfection can only hope to equal that which we have already? Very little or none.

* * *

The Same Old Story. A few days ago a party of Ohio gentlemen visited New York and Boston, taking depositions in a suit for breach of contract brought against the Jeffrey Mfg. Company of Columbus by a syndicate who at one time had an option on a controlling interest in the stock of that company. The growing importance of the Jeffrey people in the field of electrical mining machinery renders the story of this transaction of some interest to our readers.

Early in the days of the G. E. consolidation the management, in despair over the ill-success of both the Edison and T.-H. companies in the manufacture of mining machinery, endeavored to get control of the Jeffrey Company, who were even at that time making good headway in this line. They first induced some Ohio men to look into the affairs of the company and get an option on the stock. Later, for some reason not made known, they threw their own agents (the local capitalists) overboard and stepped in directly to make a trade with the Jeffrey people. The details were arranged with apparent satisfaction to both sides, and a final meeting was arranged at the Chittenden Hotel at Columbus at which Messrs. E. I. Garfield and J. R. McKee represented the G. E. Company. If McKee had been left at home the trade would no doubt have been made. As it was, when all the papers were ready to be signed, McKee felt impelled to make a speech explaining that a new clause would have to be inserted to the effect that the manufacture of the mining apparatus of the Jeffrey Company should all be transferred to Lynn, and that the factory at Columbus should be used according to the advice of the officers of the G. E. Company. This was the first that had been heard of any such proposition, and Mr. Jeffrey would not agree to it under any circumstances. Mr. McKee then made a further exhibition of his dishonesty, ignorance and bad temper, and the trade was declared off.

Returning home this shoe-peg expert purchased a Jeffrey coal-cutting machine, sent it to the shop of his company, and gave orders to build machines exactly like it in every particular. These orders were carried out. Before the G. E. Company got them on the market, however, the Jeffrey Company had produced a new type of machine, of double the efficiency, so that the G. E. mining department still finds itself out of the race as far as mining business goes.

And now, as we suppose, to get revenge against the people they tried ineffectually to rob, they have incited their former agents to sue the Jeffrey Company for breach of contract.

Deals of this nature make rather stale reading, we admit, as there have been so many, but we shall persist in reporting them until the policy of the G. E. Company has changed and the men responsible for that policy have been retired.

And J. R. McKee should be one of the first to walk the plank.

* * *

In making up the final estimate of the justice of the claims of a half dozen inventors for the production of a commercial incandescent lamp, we cannot lose sight of the fact that during the nine years of litigation, in which the Edison interests have continuously accused everybody else of piracy, *not once has there been exhibited publicly an Edison lamp made according to the specifications of the original Edison patent.* The verdict must be that Mr. Edison first got his patent, and produced his successful lamp afterwards.

No Injunction, and No Trouble in the Westinghouse Company.

With reference to the account of an alleged injunction, restraining the removal of machinery by the Westinghouse Company from its factory in Newark to its new factory near Pitttburg, the Westinghouse officials, and the three directors of the United States Company mentioned, say no such injunction has been granted nor asked for, and their knowledge of any controversy is confined to the newspaper reports of Monday morning.

Getting Ready to Fly Away.

G. E. Employes Preparing to Flit.

(From the Schenectady Union.)

Yesterday Mr. Armstron of the General Electric works again tested his flying machine at Hoffman's Ferry. For some reason it refused to work. Another trial will no doubt be made. Quite a number from this city were present yesterday.

Lamp Litigation.

The Final Bouts Will Soon Be Decided.

The Fight Has Lasted Fifteen Years.

Before January 1, 1895, the highest tribunal in the land will have finally passed upon the disputed points in regard to the invention of the incandescent lamp which have been the cause of continued controversy for fifteen years between the Sawyer-Man and Edison interests.

Argument was made on Monday and Tuesday of last week, before the United States Supreme Court at Washington, on the appeal of the suit originally brought by the Consolidated Electric Light Company vs. the McKeesport Gas Company, an Edison licensee. The patent involved is No. 317,676, dated May 12, 1885, issued to William Edward Sawyer and Albon Man, covering the discovery of fibrous or textile filaments, of horseshoe form, and being an improvement upon apparatus covered by letters patent No. 205,144 granted to Sawyer and Man on June 18, 1878.

The patent in contention was applied for in 1880, and was in interference for five years.

Judge Bradley, sitting in the U. S. Circuit Court at Pittsburg in 1889, decided adversely to the claims of the patent, since which time the case has been carried to the U.S. Supreme Court.

The arguments last week were made by Messrs. Leonard E. Curtis and Edmund Wetmore for the Westinghouse interest, and Mr. Frederick P. Fish for the General Electric Company.

The claims of the patent include :

1. An incandescing conductor for an electric lamp, of carbonized fibrous or textile material and of an arch or horseshoe shape, substantially as hereinbefore set forth.

2. The combination, substantially as hereinbefore set forth, of an electric circuit and an incandescing conductor of carbonized fibrous material, included in and forming part of said circuit, and a transparent hermetically-sealed chamber in which the conductor is inclosed.

3. The incandescing conductor for an electric lamp, formed of carbonized paper, substantially as described.

4. An incandescing electric lamp consisting of the following elements in combination: first, an illuminating chamber made wholly of glass hermetically sealed, and out of which all carbon-consuming gas has been exhausted or driven; second, an electric circuit conductor passing through the glass wall of said chamber and hermetically sealed therein, as described; third, an illuminating conductor in said circuit, and forming part thereof within said chamber, consisting of carbon made from a fibrous or textile material, having the form of an arch or loop, substantially as described, for the purpose specified.

The decision will be one from which there can be no appeal, and may be looked for within the next six weeks.

Getting Ready to Resume.

The Orient Electric Company at Youngstown, O., which manufactured incandescent lamps and employed fifty girls and women, has notified its old employes to report for duty on November 15, when the plant will resume work in all departments.

May Sell Novak Lamps.

The General Electric Company has granted permission to the Waring Electric Company to dispose of its stock of Novak lamps, about $10,000 worth, upon condition of being allowed to bid on the generators for a local railway company in which some of the Waring people owned a controlling interest.

Buckeye Lamps in New York.

The application for an injunction restraining Bloomingdale Bros. from using Buckeye lamps was argued before Judge Lacombe on Friday last. The same question is involved which Judge Dallas, in Philadelphia, recently decided in favor of the Buckeye Company, holding that lamps lawfully made in one circuit could be lawfully sold in any other circuit.

THE BATE REFRIGERATOR CASE.

Postponement for One Week.

At the opening of the Sawyer-Man case last week Chief Justice Fuller announced that the Bate refrigerator case, set down for hearing on Monday, November 4, would be postponed until Monday, November 11.

This case, it will be remembered, will settle the question as to the time of expiration of the Edison lamp patent.

A decision in favor of the Westinghouse Company in the Sawyer-Man case would, however, leave the outcome of the Bate case of no interest whatever to makers or users of incandescent lamps.

Still Fighting at Milwaukee.

The Edison Electric Light Company has made application at Milwaukee for an injunction against the Hinkle Manufacturing Company, W. G. Hinkle, Horace M. Wadleigh, Theodore A. Pamperin, Julius P. Grannert, George Beyer, Wallace P. Cook and William Harmon, who have factories at Stevens Point and Oconto, restraining them from making incandescent lamps.

It is alleged that after the Oconto injunction was issued a combination was made with the Empire Electric Company of Chicago, and that lamps have been surreptitiously made at Oconto and Stevens Point.

GENERAL ELECTRIC'S METHODS.—III.

How They Treat Their Friends.

[STAFF CORRESPONDENCE OF ELECTRICITY.]

The East Harrisburg Passenger Railway Company in the spring of 1891 discarded all their old Sprague apparatus and bought T.-H. equipment throughout. They have been purchasers of T.-H. and General Electric apparatus up to the present time, and their collection comprises the various assortment of motors that any company is bound to acquire which has bought exclusively of the T.-H. and G. E. companies. They have F. 20s, F. 30s, S. R. G.s, W. P. 50s and G. E. 800s. The East Harrisburg Passenger Railway Company were the best friends the T.-H. and G. E. companies had in Pennsylvania. In return for their loyalty the Pennsylvania G. E. Company always charged them more for apparatus than did anyone else. In the spring of 1893 the Harrisburg Company placed an order with the Pennsylvania G. E. Company for ten double motor car equipments. The price was $2,000 an equipment. On account of the depressed times only ten of the equipments were delivered, and the remainder of the order was to be held subject to shipping directions.

Before the order was filled, however, the Harrisburg Company learned that the P. G. E. Company had furnished similar motors for a very much less price to several roads in Pennsylvania not over a thousand miles from Harrisburg. A rather pointed letter caused Mr. Crowley to make a hurried trip to Harrisburg, which resulted in a reduction of $500 per car, or a total of $5,000 on the contract price.

A Historic Dynamo Sold.

The dynamo which furnished the first electric lights ever used for tower illumination was recently sold by the Wabash (Ind.) City Council to the Rose Electric Light Company of St. Louis. It was a Brush machine and was connected with the Court House tower in Wabash in March, 1880. The test was made March 28 and was witnessed by hundreds of visitors from all over the country. The outfit continued to run until 1886, when the four 2,000-candle lights were taken down and with the dynamo stored away in the City Hall. The dynamo and lamps cost $18,000 and were sold for $30.

Popular Electrical Science.

I.

The Water-pail Forge and Modifications.

BY NELSON W. PERRY, E. M.

We have all become so accustomed to the use of the expression "setting the river on fire" as a synonym of impossibility that we have long since recognized it as such. Yet in evidence of the untruth of this idea the chemist teaches us that it is a simple matter to burn water if we have but a proper igniter. The chemist, in illustration of this, drops a piece of metallic sodium upon the surface of the water, when it bursts immediately into flame. This experiment is attended with some danger, however, since the evolution of heat is so rapid as to immediately transform into steam that portion of the water closely adjacent to the sodium, and this passes off with explosive violence. The chemist will also aver that the fire thus kindled of water is unquenchable by water, and will prove it apparently in the following way: He will tie a weight to a large piece of sodium so as to cause it to rapidly sink and then throw it into the water. The sodium thus weighted, before its virtue is gone, will have been dragged perhaps many feet below the surface, but the combustion will proceed with unimpaired rapidity and the result will be a violent explosion which will project a column of water high into the air as does dynamite or nitro glycerine when subaqueously exploded. The philosophy of this is as follows: Metallic sodium has such an affinity for oxygen that it will rob even water of what it demands, and water, which consists of two parts of hydrogen and one part of oxygen, becomes thus decomposed, the hydrogen, which is very combustible, being liberated and the oxygen going to the metal. So much heat is generated by the oxidation of the sodium that the liberated hydrogen takes fire at once it comes in contact with the atmosphere. It is not, therefore, the water that is burning but the sodium, and it is the heat generated by this combustion that causes the liberated hydrogen to ignite.

The idea of utilizing water to bring metals to a welding heat would seem as preposterous at first glance as does the feasibility of setting the river on fire, but it will be seen that it has already become an accomplished fact.

Those who visited the Electricity Building at the World's Fair will doubtless long remember the water-pail forge exhibited in one of the displays at that time. A workman would pick up a bolt or a horseshoe in an ordinary pair of tongs and immerse it in an ordinary pail of water. The immersed part of the metal would at once become surrounded with a brightly luminous envelope and in a few moments when withdrawn be found to be heated throughout to a white or welding heat and ready for the blacksmith's attention on the anvil. Thus the very pail which the smith had been accustomed to use for quenching his iron or cooling it became a substitute for his forge fire and would heat up his iron in much less time.

There was, however, something back of the water-pail which gave it this remarkable property, and this was the dynamo-electric machine. A closer inspection would have shown that the positive brush of the dynamo was connected by wire to the lining of the bucket or pail, which was of metallic lead, and that the other or negative brush was similarly connected to the tongs with which the articles to be heated were handled. When the latter, clutched in the jaws of the tongs, were immersed in the water, the circuit of the dynamo became closed and the current flowed from the lead lining through the water to the iron. The question now arises, What caused the heat? The answer is, of course, that it was the electric current; but another question at once arises, "Why does the current heat the iron alone—why is the heat so intense there instead of being distributed in the water also?" The answer is this: The electric current has the property, like metallic sodium, of splitting water into its constituent parts—hydrogen and oxygen —with this difference, however, that, unlike sodium, electricity has no affinity for either of these constituents and does not break up the water by abstracting one and allowing the other to escape. Its action is rather that of the hatchet which mechanically splits apart two pieces of wood that have been glued together. But when this electrical axe falls upon the molecule of water the pieces do not fly in haphazard directions, as would the fragments of a glass ball if mechanically struck, but the hydrogen always flies off in the direction which the current takes and the oxygen flies off in the opposite direction. Thus we see when water is electrolyzed (for that is what this splitting up of the water molecules by the electric current is called) hydrogen gas escapes from the conductor which leads the current *out* of the water (or the one *towards* which the current flows in the water) and oxygen is given off at the surface of the conductor by which the current is led *into* the water (or the one *from* which the current flows in the water). Now the hydrogen which is liberated in this manner from the surface of the iron immersed in the water-pail forge forms a thin envelope of exceedingly high resistance around it, and it is to the localization of the resistance that the localization of the heat is due. The current in passing through this high resisting film heats it at once to an intensely white heat which we see the moment the iron is introduced. As time goes on (measured in fractions of a second) the heat is imparted to the iron and it becomes highly heated, even to the melting point. The water, on the other hand, being an exceedingly poor conductor of heat, is raised but little in temperature by this same process of heat conduction.

There is another reason, however, why the surrounding water remains comparatively cool which is more potent than the poor heat conductivity of the water. Everyone has doubtless noticed that a globule of water will dance around on a red hot stove lid for quite a while, whereas it will be immediately vaporized on the much cooler surfaces of the stove. They have also doubtless noticed that a white-hot poker thrust into a bucket of water will not cause the water to splutter or boil, whereas the same poker cooled off to dull redness or below will cause a violent ebullition or spluttering. The cause of the quiescence at the high temperatures is that at those temperatures the water assumes what has been aptly termed the "spheroidal" state, which means that a cushion of vapor is interposed between the water and the iron so that the water does not come in contact with the iron at all. When the iron is cooler, however, this cushion of steam does not form, the water wets the iron and is at once driven off into vapor with almost explosive violence. In the water-pail forge, on account of the intensely heated envelope of hydrogen surrounding the iron, the water also takes the spheroidal state and we have the phenomenon of iron being raised to a welding heat or higher while submerged in water, without spluttering or violent disturbance of the latter, and also without rapidly imparting its heat to it.

This process is usually ascribed to Messrs. Soho and Lagrange, two Belgian electricians, but their claims to the invention seem to have been successfully disputed and it is believed to be open to all to use.

While pure water may be used in the pail its electrical resistance is too great for the most economical results, so recourse is had to solutions of various salts or acids whose conductivities are much greater than that of pure water. About the only other precaution necessary is that the metal by which the current enters the liquid be not soluble or readily oxidizable in the solutions employed in the bath. Lead answers these requirements with most solutions and is also cheap and is therefore most commonly used.

This process, besides being exceedingly interesting from a scientific point of view, has also been put into practical use in the arts for heating rivets, etc., which it does in less time than it can be done by the forge fire. It has also been suggested as applicable to the tempering of steel tools, it being argued that the heat can thereby be more closely regulated, that there will be a consequent removal of all chances of burning the metal, and that the heating and tempering may be accomplished at one operation, without the removal of the tool from the bath, by simply breaking the current when the required temperature is reached and allowing the quenching to proceed in the bath in which the heating occurred. Those opposed to this view argue that since at present the temper is always determined by the color which the cooling steel assumes, the water-pail forge, by the very fact of its prevention of the formation of the oxide film to which the color is due, would leave the operator without any safe guide as to when the quenching should take place for any desired temper, and that it would therefore introduce an element of uncertainty.

A modification of this process, intended to adapt it to welding processes, is the following: The pieces of metal to be united are held in clamps and adjusted to each other, as in the Thomson electric welding process. That is to say, the surfaces to be welded are brought face to face. Directly above the proposed weld is suspended the vessel containing the acidulated water, and a jet issuing from the bottom of this vessel is allowed to play upon the proposed joint. This water jet forms the electrical connection between the pail and the metal, so that if now the former be connected with the positive brush of the dynamo and both pieces of the metal to be welded be connected with the negative brush, the abutting surfaces upon which the water is playing will become heated in the same way and for the same reason as before. When the proper temperature is reached the surfaces are pressed together and the weld is complete.

This method of welding by means of the water-pail forge has not yet come into use and its feasibility has not yet been established, but the "water-jet forge," as this may be appropriately called, would seem to allow of a large variety of applications in which there would be literally accomplished the paradoxical feat of heating or even melting of a surface of metal by the playing upon it of a jet of cold water.

An officer of the Japanese Navy has written a letter to a friend in this country, in which he speaks highly of the efficiency of several American electric searchlights used in the fleet to which he is attached. These lights stood the the test of actual service better than the English and German apparatus, which will be doubtless condemned by a board of survey. He also states that the best maps of the Yellow Sea and Corea are from the United States Hydrographic Office in Washington; these maps and charts are compiled with the latest data, and the principal roads in Corea are clearly indicated.

Electric welding has been used to remedy blowholes in defective castings by first drilling out the defects and then heating the casting and introducing scraps of steel, which are melted by electricity, making a perfect joint without a seam or flaw of any kind.

UTILIZATION OF WATER POWER IN ENGLAND.

(From our London Correspondent.)

Public bodies in England have been slow to realize the great waste of power there is in her rivers, lakes and other waters. From time to time large projects for the utilization of this waste power have been rumored, but until lately no scheme of any importance has been carried out, though a number of small installations worked by water power are in existence here. From the English electrical engineer's point of view the electric lighting works opened the other day at Worcester are regarded as unique and of a more or less experimental nature. The waters of the river Teme, upon which the town of Worcester stands, are now used for running dynamos for the generation of electric current, the work being in the hands of the corporation. The water powers purchased are equivalent to 850,000 H. P. hours per annum. The generating station is situated on the site of the ancient Powick Mills. The plant comprises two Victor turbines of 30" and 48" respectively, connected by ropes to a Mordey alternator. The 30" turbine on a fall of 14 feet is 66 H. P., and the 48" is 204 H. P. These two are, when working, equal to the full power of the alternator. There are also two sets of 54" turbines, giving 266 H. P. each, arranged side by side with 286 H. P. Raworth engines. There are three wheelpits and three sets of sluice gates. The turbines are of the vertical cylinder gate type. They are each automatically controlled by a Snow governor. The alternators have each an output of 125,000 watts. There are three main engines, each capable of developing 286 H. P. These are of the Brush compound vertical type with 15" x 25" cylinders with 16" stroke.

One of the smaller towns lighted by means of water power is Lynmouth, and one of the most notable of similar private installations is that of Lord Salisbury, ex-Premier of Britain, at his country residence at Hatfield.

A company has secured the right to utilize the fall of water from the southern end of Lake Windermere, which is stated to be the best piece of water power in England, being equal to 40,000 I. H. P., and here works are to be constructed for converting this into electricity. Powers are to be asked for in the next session of Parliament to supply an area of ten miles from the lake, including several towns in the vicinity.

Another project in the far-famed lake district is the proposal to utilize the waters of the river Kent for the purposes of electric traction and lighting. An electric tram line is to be constructed from the Furness district to Bowness with an auxiliary undertaking of eventually carrying it through to Ambleside. The water rights have already been secured by the promoters of the scheme.

Chatsworth Hall, the country mansion of the Duke of Devonshire, is the largest private installation of the water-power kind in this country, a lake in the grounds being brought into use for the purpose.

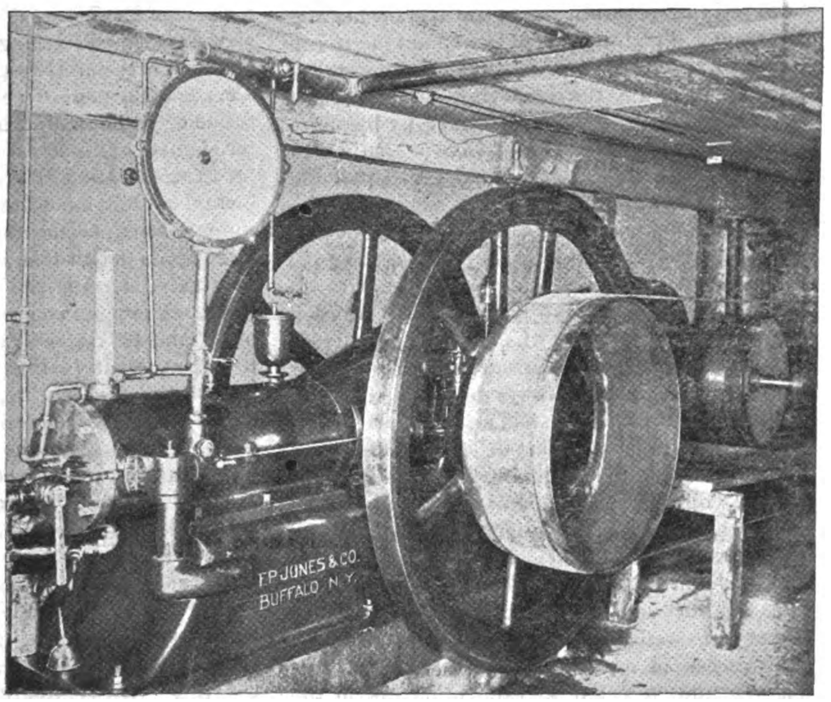
"The Comet."

Pittsburg is fast making her way into the ranks of the leading cities of America. Judged by her newspapers she has long been far in advance of other cities of equal population. To her long list of entertaining and instructive publications has now been added *The Comet*, an illustrated weekly in lighter vein, which has already achieved great popularity, as it deserved. Mr. E H. Heinrichs, who is interested in the publication, has had an extended newspaper experience, knows what the public wants, and we are certain that *The Comet* will be seen in Pittsburg a great deal oftener than the sun.

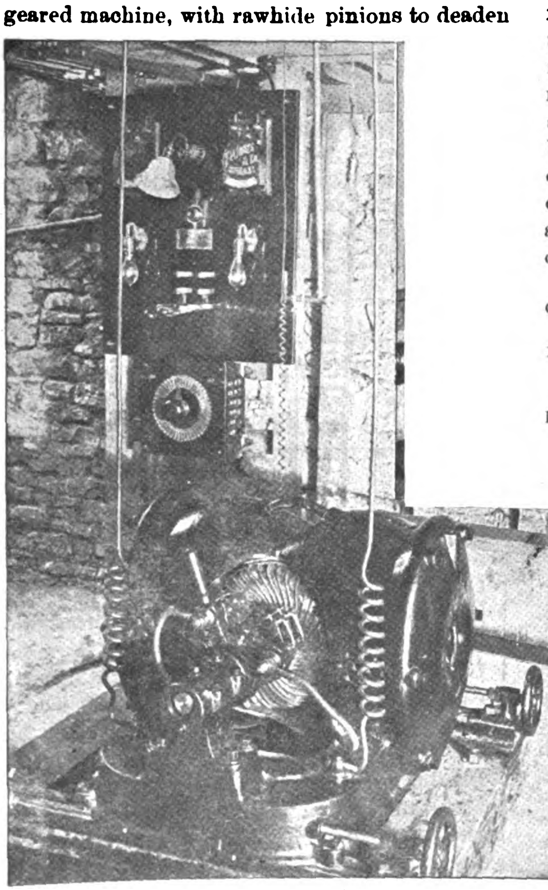
GAS ENGINES FOR MOTIVE POWER.

Their Economy for Running Isolated Plants.

The practice of driving small isolated electric lighting plants by gas engines has been quite extensively introduced abroad and its economy over steam plants for small units is very generally conceded, but for some reason plants of this description have found but little favor in this country and but comparatively few of them are to be found. An installation of this kind in Buffalo has been brought to our attention, and while its environments are unusually auspicious, it serves as an excellent example of the economy which may be attained under favorable circumstances.



The plant in question is situated in the basement of the clothing store of Weill & Co., of Buffalo, where the use of natural gas offers a particularly economical fuel supply, which, it is only fair to admit, cannot be approached in cost in most localities. The plant consists of a seventeen horse power gas engine and a 175 light dynamo. The engine also furnishes power for a passenger elevator. The engine is placed on a solid masonry foundation with a good layer of hair felt beneath it. The countershafting is all on piers built up from the ground. The elevator is a "Howard" geared machine, with rawhide pinions to deaden the sound. The engine is belted to a countershaft from which is belted the elevator, the dynamo jackshaft and the compressor pump. The jackshaft is provided with a tight and loose pulley, as the dynamo is not used except as the light is needed, while the engine is run all day on account of the elevator. The jackshaft carries a 700 pound flywheel to keep the light steady.



The automatic starting device is simply a pipe, with a lever cock in it, run from a galvanized iron tank to the cylinder of the engine. Air is pumped into the tank to about 80 pounds pressure, while the engine is running, and kept there by suitable stopcocks until it is desired to start again, when the engine is given a start by opening and quickly closing the valve between the tank and cylinder, with the piston in the right position to get the benefit of the pressure. Once started the gas explosions commence and the engine soon gets up to speed

The engine is made by American manufacturers and it is hoped that a thorough trial will show that it is up to the standard of foreign machines.

The dynamo and switchboard shown in the illustrations have a capacity of 175 lights, and the fact that the whole plant is in charge of a man who has had no previous experience with machinery is a demonstration of the simplicity and practicability of a plant of this kind. It has been in continuous service since the latter part of August and was installed by F. P. Jones & Co., of Buffalo, who furnish the following comparative prices for the central station service and that of the isolated plant:

CENTRAL STATION PRICES.

Current for 5 H. P. motor at $15 per month (minimum charge), per year	$180.00
150 lights 4 hours per day (60 watt lamps), 36,000 watt hours at 14 cents (net) per M, per day, $5.04; per year	1,512.00
Interest and depreciation on cost of motor, 10 per cent. on $350	35.00
Total	$1,727 00

INDEPENDENT PLANT PRICES.

Average 3 H.P. for elevator, 14 hours day, and 15 H. P. for lights, 4 hours per day, 102 H. P. hours—consumption of gas, 17 cubic feet per H. P. hour; cost of gas at 25 cents per M feet, per day, $0.4335; per year	$130.05
Interest and depreciation on investment—engine, $1,550; dynamo and instruments, $550; total, $2,100; 10 per cent. interest on $2,100	210.00
Total	$340.05
Showing a saving per year of	$1,386.95

While these figures are not applicable to general cases they show the possibilities of economical isolated plants where gas is obtainable at a moderate cost.

Figuring this out on a basis of gas at $1.50 per thousand cubic feet, in order to make comparisons easy, we find, allowing 10 lamps per H. P. the actual cost would be ⅓ cent per lamp hour. This approaches very closely the figures given by the gas engine manufacturers, which are ¼ cent per lamp hour, based doubtless upon an engine performance at maximum load.

On the Velocity of Cathode Rays.*

BY J. J. THOMSON, M.A., F.R.S.

The phosphorescence shown by the glass of a discharge tube in the neighborhood of the cathode has been ascribed by Crookes to the impact against the sides of the tube of charged molecules driven off from the negative electrode. The remarkably interesting experiments of Hertz and Lenard show that thin films of metal when interposed between the cathode and the walls of the discharge tube do not entirely stop the phosphorescence. This has led some physicists to doubt whether Crookes's explanation is the true one, and to support the view that the phosphorescence is due to ethereal waves of a very small wave length, these waves being so strongly absorbed by all substances that it is only when the film of the substance is extremly thin that any perceptible phosphorescence occurs behind it. Thus on this view the phosphorescence is due to the action of a kind of ultra violet light, which possesses in an exaggerated degree the property possessed by the ultra violet rays of the sun of producing phosphorescence when incident upon such substances as German or uranium glass. It is perhaps worth while to observe, in passing, that the light produced in an ordinary discharge tube by an intense discharge is very rich in phosphorogenic rays. I have been able to detect phosphorescence in pieces of ordinary German glass tubing held at a distance of some feet from the discharge tube, though in this case the light had to pass through the glass walls of the vacuum tube and a considerable thickness of air before falling on the phosphorescent body.

The view to which Lenard has been led by his experiments, that the cathode rays are ethereal waves, demands the most careful consideration and attention, for if it is admitted it follows that the ether must have a structure either in time or space for these cathode rays are deflected by a magnet, which, so far as our knowledge extends, does not produce any effect on ultra-violet light unless this is passing through a *refracting* substance: thus, if the cathode rays are supposed to be ultra-violet light of excessively small wave-length, it follows that in the ether in a magnetic field there must either be some length with which the wave-length of the cathode rays is comparable, or else some time comparable with the period of vibration of these rays.

It might be objected that it is possible that the action of a magnet on the cathode rays is a secondary effect, and that the primary action of the magnet is to affect the main current of the discharge passing between the positive and negative electrodes, and thus to alter the distribution of the discharge entering the cathode; this would affect the distribution of the places of greatest intensity over the cathode, and thus indirectly the distribution of the waves emerging from it. To test this point I shielded the cathode from magnetic forces by means of a magnetic screen consisting of a ring made of soft iron wire; the length was about 1·5 ins., its thickness was about 0·75 in. When this ring encircled the cathode a magnet was brought up to the tube; the phosphorescent patches inside the ring were now affected by the magnet, but those on the parts of the tube farther away from the cathode and outside the iron ring were very much displaced by the magnet; thus proving that the magnet acts on the cathode rays through the whole of their course, and does not merely affect the place on the cathode at which they have their origin. There thus seems no escape from the conclusion that the establishment of the hypothesis that the cathode rays are ethereal rays would also prove the finiteness of the structure of the ether.

The following experiments were made with the view of determining the velocity with which the cathode rays travel, as it seemed that a knowledge of this velocity would enable us to discriminate between the two views held as to the nature of the cathode rays. If we take the view that the cathode rays are ethereal waves, we should expect them to travel with a velocity comparable with that of light; while if the rays consist of molecular streams the velocity of these rays will be the velocity of the molecules, which we should expect to be very much smaller than that of light.

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* From the *Philosophical Magazine*.

The method I employed is as follows: The discharge tube was sealed on to the pump, and the two ele trodes were placed at the neck of this tube. The discharge tube was covered with lamp-black, with the exception of two thin strips in the same straight line from which the lamp-black was scratched; these strips were about 10 cm. apart; the one nearest to the negative electrode was about 15 cm. from the electrode, the other was 25 cm. from the electrode. They were chosen so as to phosphoresce with, as nearly as could be judged, equal brilliancy when the discharge passed through the tube.

The light from the phosphorescent strip fell upon a rotating mirror about 75 cm. from the tube. This mirror is the one used by me in my experiments on "The Velocity of Propagation of Electric Discharge through Gases" (Proc. Roy. Soc., 1890,) and is described in that Paper. The only change made in the mirror was to replace the single plane strip of silvered glass which was used in the previous experiments by six strips of mirror fastened symmetrically round the axis. The mirror was driven by a large Gramme machine.

The images formed by reflection from the mirror were observed through a telescope, of which the object-glass was a large portrait photographic lens of 4 in. aperture, the eye piece a short-focus lens; when the mirror was at rest the two images of the phosphorescent strips were seen in the same straight line, and the adjacent ends of the two images were brought into coincidence by inserting between one of the phosphorescent strips and the mirror a very acute-angled prism. The point of the experiment was to see if the images of the two phosphorescent strips remained in the same straight line when the mirror was in rapid rotation. If, for example, the cathode rays traveled with the velocity of sound they would take about $\frac{1}{3300}$th of a second to pass from one strip to the next; if the mirror were rotating 300 times a second it would, in the interval taken by sound to pass from one strip to the next, rotate through about 33 degs.; the displacement of the image produced by a rotation one-thousandth part of this could easily be detected.

When the phosphorescence was produced by the discharge of an ordinary induction-coil, the images seen in the telescope after reflection from the revolving mirror were drawn out into very faint ribbons of light without definite beginnings or ends, so that it was impossible to say whether or not there was any displacement of one image relative to the other

I tried a considerable number of phosphorescent substances in the hope of obtaining sharp images, but without success. The substances I tried were ordinary German glass, uranium glass, lead glass, the cyanide of magnesium and platinum, asaron, æsculine, and Schuchardt's "leuchtfarbe."

The gradual fading away of the phosphorescence after the exciting cause has been removed, is one reason why one of the edges of the image formed by the revolving mirror should be indistinct; this cannot be remedied unless some substance can be found which ceases to phosphoresce immediately the incidence of the negative rays ceases. I was unable to find any substance possessing this property; of the substances I tried, uranium glass was the one whose phosphorescence died away most quickly.

I tried several experiments with a specimen of asaron. This substance was found by Lenard to cease to phosphoresce so quickly after the cessation of the phosphorogenic rays that he could not detect its duration in his very sensitive phosphoroscope. My specimen of asaron must, I think, have been impure, as it phosphoresced a coral pink instead of violet, as described by Lenard, and its phosphorescence showed a very appreciable duration; in addition to this, it did not give out nearly enough light to be of any use in experiments of this kind.

But even though the images of the phosphorescent strips have one edge (that corresponding to the end of the phosphorescence) indistinct, we can get the information we require about the velocity of the cathode rays if we can get the image of the edge corresponding to the beginning of the phosphorescence sharp and distinct.

After unsuccessful attempts with several methods, I found that this could be done in the following way, using the oscillatory currents produced by the discharge of a Leyden jar: The electrodes of the discharge tube were connected with the ends of the secondary coil of a transformer, whose primary circuit consisted of a coil of wire with the ends connected to the outside coatings of two Leyden jars, the inside coatings of which were connected with the extremities of an induction-coil; the secondary coil of the transformer had about thirty turns for each turn of the primary coil. It was heavily insulated, and both primary and secondary were immersed in an oil-bath. This transformer easily gave sparks 7 ins. or 8 ins. long in air, and when connected to the terminals of a discharge tube made of uranium glass produced a very vivid phosphorescence. When the phosphorescence was produced in this way, the images after reflection in the rotating mirror had one edge sharp and distinct, though the other edge was indeterminate in consequence of the duration of the phosphorescence.

When the images of the two bright phosphorescent strips were observed in the telescope, after reflection from the rapidly revolving mirror, their bright edges were seen to be no longer in the same straight line; if the images came in the field of view from the bottom and went out at the top, then the sharp edge of the phosphorescent strip nearest the electrode was lower than the edge of the other image; if the direction of rotation of the mirror was reversed so that the images came in at the top of the field of view and disappeared at the bottom, then the bright edge of the image of the phosphorescent strip nearest the negative electrode was higher than the bright edge of the image of the other strip. This shows that the luminosity of the strip nearest the cathode begins to be visible before that at the strip more remote; and that the retardation is sufficiently large to be detected by the revolving mirror. This retardation might be explained (1) by supposing it due to the time taken by the cathode rays to traverse the distance between the phosphorescent patches; or (2) we might suppose that, though the cathode rays reached the two phosphorescent patches almost simultaneously, it took longer for the rays falling on the patch at the greater distance from the cathode to raise the patch to luminosity. In other words, there may be an interval between the incidence of the cathode rays and the emission of the phosphorescent light, this interval being greater the further the phosphorescent patch is from the cathode. This latter supposition cannot, however, explain the displacement of the images for the following reasons: The sharpness and brightness of the edge of the image show that the phosphorescence, when once it is visible, must attain its maximum brilliancy in a time very small compared with the time taken by the mirror to rotate through an angle large enough to produce the observed displacement of the images. Again, the two phosphorescent patches are as nearly as possible of equal brightness, so that there can be very little difference in the intensity of the cathode rays falling upon them; it was for this reason that both the phosphorescent patches were taken some distance down the tube. Again, I took a tube which was bent so that the cathode rays fell more directly upon the patch farther from the cathode than upon the other patch, so that in this case the phosphorescence of the more remote patch was brighter. The displacement of the images with this tube was just the same as for the previous, i. e., the phosphorescence commenced at the patch nearest the cathode sooner than at the other patch, whereas, if the displacement of the images was due to the interval between the arrival of the rays and the beginning of the phosphorescence it should have commenced at the patch farthest from the cathode, as this was the most exposed to the cathode rays and phosphoresced with the greatest brilliancy.

I conclude, therefore, that the displacement of the images is due to the time taken by the rays to travel from one patch to the other. This displacement enables us to measure the velocity of the cathode rays. The amount of displacement observed through the telescope is not constant; even though the mirror is turning at a uniform rate, there are quite appreciable and apparently irregular variations in the amount of the displacement of the images seen in the course of a few minutes. I think these are due to irregularities in the sparks discharging the jar, and the consequent irregularities in the electromotive force acting on the discharge tube.

When the mirror was rotating 300 times a second, the bright edges of the two patches were on the average separated by the same distance as the image of two lines 1·5 mm. from each other placed against the discharge tube. Since the distance of the discharge tube which contained hydrogen from the mirror is 75 cm., the mirror must, in the time taken by the cathode rays to pass from one patch to the other, have turned through the angle whose circular measure is

$$\frac{1\cdot5}{2\times750}.$$

Since the mirror makes 300 revolutions per second, the time it takes to rotate through this angle is

$$\frac{1\cdot5}{2\times750\times2\pi\times300}=\frac{1}{6\pi\times10^5};$$

and since the distance between the patches is 10 cm. the velocity of the cathode ray is

$$6\pi\times10^6\text{cm./sec.},$$

or about

$$1\cdot9\times10^7\text{cm./sec.}$$

This velocity is small compared with that with which the main discharge from the positive to the negative electrode travels between the electrodes (see J. J. Thomson, Proc. Roy. Soc., 1890). I verified this by inserting an electrode into the far end of the tube used in the previous experiment, and observing the images formed when a bright discharge passed down from the electrode at the beginning to the electrode at the end of the tube. The light from the luminous gas shines through the places where the lamp-black has been scraped from the tube, and we get two images, which, when the mirror is at rest, coincide in position with the images of the two phosphorescent patches in the previous experiment. These images, however, unlike the phosphorescent one, remained in the same straight line when the mirror was rotating rapidly, thus proving that the velocity of the main discharge is very large indeed compared with that of the cathode rays.

The velocity of the cathode rays is very much greater than the velocity of mean square of the molecules of gases at the temperature 0° C. Thus, for example, at 0° C. the velocity of mean square of the molecules of hydrogen is about $1{\cdot}8 \times 10^5$ centimeters per second: the velocity of the cathode rays is about one hundred times as great. The velocity of the cathode rays found from the preceding experiments agrees very nearly with the velocity which a negatively electrified atom of hydrogen would acquire under the influence of the potential fall which occurs at the cathode. For, let v be the velocity acquired by the hydrogen atom under these circumstances, m the mass of the hydrogen atom, V the fall in potential at the cathode, e the charge on the atom; then we have, by the conservation of energy,

$$m\,v^2 = 2\,V\,e.$$

Now e has the same value as in electrolytic phenomena, so that $e/m = 10^4$.

Warburg's experiments show that V is about 200 volts, or 2×10^{10} in absolute measure. Substituting this value, we find

$$v^2 = 4 \times 10^{14},$$

or

$$v = 2 \times 10^7 \text{cm.}/\text{sec},$$

a value almost identical with that found by experiment. The very small difference between the two is, of course, accidental, as the measurements of the displacement of the images on which the experimental value of v was founded could not be trusted to anything like 5 per cent.

The action of a magnetic force in deflecting these rays shows, assuming that the deflection is due to the action of a magnet on a moving electrified body, that the velocity of the atom must be at least of the order we have found.

Consider an atom projected parallel to the axis of the tube which is situated in a uniform field of magnetic force, the lines of magnetic force being angles to the axis of the tube. Let H be the intensity of the magnetic force. Then if m is the mass of the atom, v its velocity, and ρ the radius of curvature of its path, we have

$$\frac{m\,v^2}{\rho} = H\,e\,v,$$

where e is the charge on the atom; since e/m for hydrogen is 10^4, we have

$$v = \rho\,H \times 10^4.$$

I cannot find any quantitative experiments on the deflection of these rays by a magnet; but ordinary observation shows that it would require a strong magnetic field to make ρ as small as 10 cm., which would mean clearing the tube of phosphorescence except within about 10 cm. of the cathode. If v were 2×10^7, this would give $H = 200$, which is not extravagant.

Westinghouse Wins.

The contract for the lighting plant for the Allegheny City (Pa.) Court House has finally been awarded to the Westinghouse Company. This contract was first voted to the Western Electric Company, the lowest bidders, but the local feeling in favor of the home concern finally prevailed.

The Brooklyn Electrical Society.

The members of the above society at the regular weekly meeting on Thursday evening last had the pleasure of hearing an interesting paper by Mr. W. C. Otten, vice-president of the Association, on the subject of "Electric House Wiring."

Changes in the Firm of Queen & Co.

Messrs. James G. and William Biddle, Jr., announce that they have severed their connection with Queen & Co. Incorporated. Mr. James G. Biddle [illegible] now located at 119 South Fourth street, Philadelphia.

The Chemical Theory of Accumulators.—IV.

BY E. J. WADE.

The only theory that now remains to be examined thermo-chemically is the generally accepted one of the direct formation of lead sulphate at both electrodes by the abstraction of two molecules of sulphuric acid, which are replaced by two molecules of water. The chemical equation for the ultimate products of this reaction is :

$$PbO^2 + 2H^2SO^4 + Pb = PbSO^4 + 2H^2O + PbSO^4.$$

It is a little difficult to express these changes in an electrolytic equation, but the following, perhaps, illustrates what apparently occurs :

$$\begin{array}{c|c|c|c|c|l} SO^4H^2 & & SO^4 & H^2 & & \\ PbOO & H^2SO^4 & Pb{=}Pb & O & OH^2 & SO^4Pb. \end{array}$$

It will be noticed that the second molecule of sulphuric acid (placed above PbO^2) does not appear to undergo ordinary electrolytic decomposition, but combines what is usually termed a *secondary* reaction and one which is so often supposed not to contribute anything to the electrical activity of the cell.

The usual form of the thermo-chemical equation for the above reactions is as follows:

$$\begin{array}{l} [2Pb,SO^4] + [2H^2,O] - [2H^2,SO^4,Aq] - [Pb,O^2] \\ 225940 + 136720 - 215060 - 62300 \\ = 85300. \\ = 1{\cdot}855 \text{ volts.} \end{array}$$

This figure, while considerably higher than those obtained from any of the previous equations, and approaching nearer to the observed E. M. F., yet falls short of it by a very appreciable amount, the discrepancy being quite sufficient to suggest that it does not fully represent what actually occurs. It will be noticed, however, that it is assumed that the acid is diluted with an infinite or very large quantity of water; practically speaking, that a very dilute solution of acid is employed. Now Messrs. Armstrong and Robertson and others have suggested that the real electrolyte is either pure sulphuric acid or one of its simplest hydrates, and that the energy absorbed in abstracting this from the solution during discharge is supplied by the cooling of the cell which then takes place. If this is so, it obviously must not be taken into account when calculating the E. M. F., which will be entirely independent of the degree of dilution of the acid.

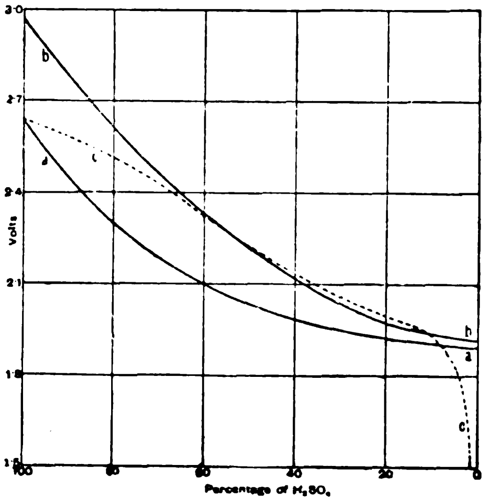


FIG. 1.

On this assumption the thermo-chemical equation for pure sulphuric acid is :

$$\begin{array}{l} [2Pb,SO^4] + [2H^2,O] - [2H^2,SO^4] - [Pb,O^2] = \\ 225940 + 136720 - 179360 - 62300 = \\ 121000. \\ 2{\cdot}63 \text{ volts.} \end{array}$$

This result is of course simply that given by the previous equation, plus the energy liberated by the complete hydration of two molecules of sulphuric acid (2×35700 calories $= 0{\cdot}775$ volt), and is about twice as much too high as the preceding value was too low ; which seems to indicate that the explanation of the discrepancy does not lie in that direction. Besides this, the researches of Messrs. Gladstone and Hibbert have proved conclusively that, in some way or another, the E. M. F. of a cell does not depend on the strength of acid employed. Their observations included measurements of the E. M. F. in all strengths of acid, from water containing the merest trace up to the very strongest acid that could be procured, and the mean result of the whole of them is embodied in curve c, Fig. 1. Most of their values for the higher percentages of acid were obtained with only the peroxide plate in the strong acid on account of the excessive local action that took place at the spongy lead plate under similar conditions, and these figures have therefore had to be corrected for both plates in the same strength of acid from the data they themselves furnish of the E. M. F. between two plates of plain lead in different strengths of acid.

Only the middle portion of this curve can be considered to correspond with the normal reactions represented in the thermo-chemical equation. The rapid fall of E. M. F. which commences with about a 10 per cent. solution, and becomes very marked for strengths below 5 per cent., is due to the formation of basic sulphate and oxide which Messrs. Gladstone and Tribe long ago showed to take place in weak acid. The turning over or flattening of the curve for the highest strengths of acid does not appear to have been specially noticed; but it is, no doubt, due to the local action, which takes place with increasing rapidity in 40 to 50 per cent. solutions (Sp. Gr. 1·300 to 1·400) and upwards, and it might, in fact, have been predicted by *a priori* reasoning from the results of experiments by various investigators on the effects of local action on the E. M. F. of primary cells.

To ascertain how far this curve agrees with the calculated E. M. F. for various strengths of acid, intermediate values must be interpolated between the two extreme values already obtained for pure acid and for very dilute acid by substituting successively the heat formation of $[H^2,SO^4,H^2O]$ $[H^2,SO^4,2H^2O]$, $[H^2,SO^4,5H^2O]$, and so on in the thermo-chemical equation in place of $[H^2,SO^4]$, and the resultant curve is given in curve *a*, Fig. 1. On comparing the two curves A and C it will be observed that, as Messrs. Gladstone and Hibbert have already pointed out, they only coincide at two places—namely, for about 7 per cent. acid and for 100 per cent. of pure acid—and that for all other strengths the observed are considerably higher than the calculated figures. Now both these points of coincidence occur at parts of the curve of observed values where, as has been mentioned above, it corresponds to abnormal reactions whose resultant E. M. F. is lower than that normally to be expected, and it suggests the probability, therefore, that the agreement is only an accidental one and that—except for very weak acid, where the reason for the rapid fall of E. M. F. is known—a discrepancy still remains to be accounted for throughout its length, due perhaps to some portion of the reactions not having been properly or fully stated in working out the thermo-chemical equation.

A further and closer examination, however, of the changes occurring in the electrolyte shows that a reaction does exist which up to the present appears to have been overlooked. Full allowance has been made for the energy required to separate two molecules of acid from the water with which it is diluted, but no account has been taken of the energy due to the further dilution of the remaining acid by this liberated water together with the two molecules of water which replace the acid that has been used up. As an example of the difference made by this correction and the way it is applied, the case may be considered of a solution whose strength is represented by the formula $H^2SO^4,19H^2O$, corresponding to 22·3 per cent. of acid by weight or a density of about 1·163. The ordinary thermochemical equation, without taking this extra reaction into account, is :

$$\begin{array}{llll} [2Pb,SO^4]+[2H^2,O]- & [2H^2,SO^4,19H^2O] & - & [Pb,O^2] \\ 225940 \quad + 136720 - & 211870 & - & 62300 \\ = 88490. & & & \\ = 1\cdot923 \text{ volts.} & & & \end{array}$$

Now the term to be added for the heat generated by the further dilution of the acid remaining is $+[x(H^2SO^4 19H^2O),\ 2\ (19H^2O + H^2O)] = 3520 = \cdot077$ volt, and $1\cdot923$ volts $+ \ 0\cdot077$ volt $= 2\cdot0$ volts.

x may stand for any quantity or number of molecules of dilute acid so long as it is sufficiently large that the addition of the extra water—in this case·40 molecules—does not sensibly alter its degree of dilution.

If the corresponding correction is made for the extreme case of perfectly pure acid, it will at once be apparent that the only water here liberated are the two molecules that replace the decomposed acid, and these combined with the remainder to such good effect that about 20,000 calories are liberated, equivalent to an additional ·435 volt. For the other extreme of a very weak solution, the acid is already so fully diluted that hardly any more heat can be generated whatever further quantity of water is added, and consequently the correction becomes comparatively small; but at the point, where the E. M. F. drops off sharply—that is, about a six per cent. solution —it is still sufficiently large to be worth considering. Curve *b*, Fig. 1, gives the calculated E. M. F. *with the above correction* for all strengths of solution, and it will be observed that it practically coincides with the one giving the E. M. F. obtained by actual measurement, for solutions containing from 10 to 65 per cent of acid, or thereabouts, corresponding to specific gravities from 1·070 to 1·570, which is a far wider range than is ever used in practical cells. Above 65 per cent. the curve of observed E. M. F.'s commences to fall away from the other, and continues to do so right up to 100 per cent., which is exactly what might be expected, and the reason for which has been already explained.

It may now fairly be claimed that the double sulphating theory of discharge does account for the E. M. F. of lead storage cells strictly in accordance with Thomson's law, while none of the others do so even approximately; and, from a thermo-chemical point of view, therefore, its case may be considered as proved.

Although it might not at first sight appear probable that such a minor matter as that of the rate of dilution of the acid in a cell during discharge could have any practical bearing on the design of accumulators, yet it does suggest some considerations regarding the amount of acid required and its best distribution which are of considerable interest. The results to which they lead have long ago been more or less completely recognized as the outcome of actual experience, without a very clear comprehension of the underlying reason, and they will bear a little further emphasizing and explanation. It has already been mentioned that in the early days of lead accumulators the only function supposed to be served by the sulphuric acid was to render the electrolyte conductive, and that its presence in large quantities was considered to be actually injurious. But as soon as it was admitted that sulphating was one of the normal processes of discharge, it followed, as a necessary corollary, that at least the theoretical amount requisite for this purpose must be supplied and a little over to prevent the solution from being reduced to pure water by its complete abstraction. Experience, however, quickly demonstrated that a cell worked far better when a large excess of acid was present so as to prevent the specific gravity from falling too low or varying between too wide limits, and a proportion of from three to five times the necessary amount was finally adopted and has remained the general practice ever since.

Next it was found that not only must the quantity of acid in the solution be large, but it must also have a free access to the surface of the electrodes; and experiment showed that, within certain limits, cells worked more efficiently the further the plates were apart, in spite of the fact that the losses due to internal resistance must be proportionally increased. More recently, the researches of Messrs. Gladstone and Hibbert into the variations of E. M. F. with strength of acid, and of Messrs. Duncan and Wiegand into the rates of diffusion from the active material into the surrounding liquid, have incidentally confirmed the necessity of providing for a rapid diffusion and free supply, not only throughout the main body of the electrolyte at the surface of the electrodes, but also with regard to the whole mass of the active material and the acid contained within its pores. Now, although unconsciously, the tendency and ultimate object of every one of these modifications is to enable the utmost energy to be obtained from the recombination of the liberated water, with the conversion of the largest possible percentage of it into electrical work and the smallest possible percentage into heat. That an insufficient supply of acid causes a reduction in the practical capacity of a cell, and that a poor circulation throughout the bulk of the electrolyte, or an impeded diffusion within the pores of the active material, causes both this and an actual loss of efficiency as well, may be proved by considering the following hypothetical case.

Suppose a set of positive and negative plates are run down in a cell holding very little more acid than is theoretically sufficient for their discharge, but standing in another vessel which contains a much larger quantity of acid of the same specific gravity. The two liquids are completely separated by the inner cell; but when required it can be removed, leaving them in free communication. On the completion of the discharge a certain amount of energy will have been given out in watt hours, and the electrolyte reduced to an extremely weak solution of acid. The inner vessel is next removed and the two solutions allowed to mix. The dilution of the stronger by the weaker acid causes the liberation of a definite quantity of heat, which could be measured by suitable apparatus, and its electrical equivalent in watt hours calculated.

Now, if the dividing cell had been removed *before* the discharge began, and the plates run down in the larger quantity of acid, it is evident that, the final conditions being the same, the total amount of energy liberated must be equal to that given out electrically when the discharge took place in the smaller vessel, plus the heat generated in mixing the liquids; but *the whole of it will now appear as electrical energy*, the difference being shown by the higher and more constant E. M. F. maintained owing to the strength of acid for corresponding periods of the two discharges always being greater in the latter than in the former case.

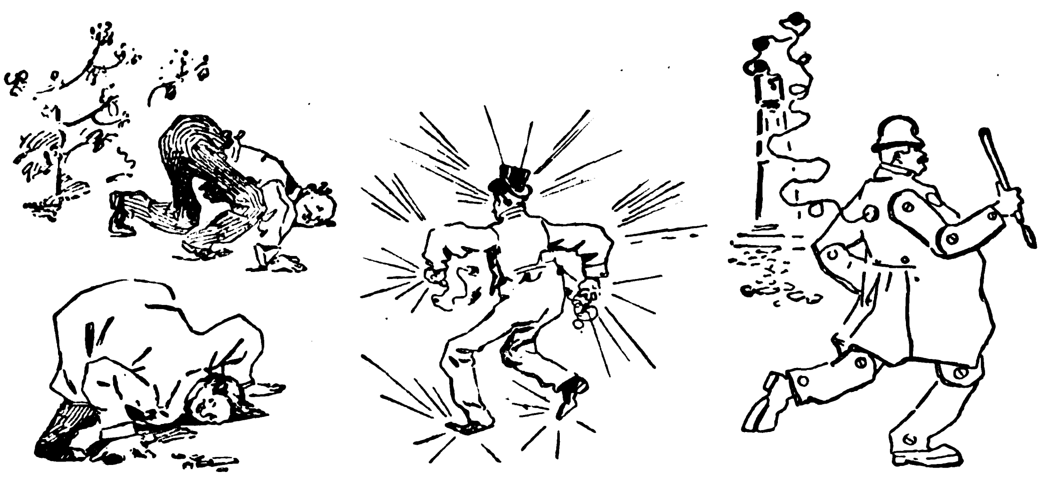
Practically, then, an insufficient supply of acid means a rapid fall of voltage during discharge, and indirectly, therefore, a smaller output in ampere hours, because the maximum permissible drop of E. M. F. will be reached at an earlier stage.

A consideration, however, of what takes place during recharging will show that the *efficiency* is not affected or reduced. If the cell is charged in the larger quantity of acid, the work that must be done upon it will exceed that necessary if charged in the smaller cell by the amount that was liberated on mixing the two solutions; but this is just the amount by which the energy of the one exceeded that of the other during discharge, and, therefore, the ratio in watt hours of charge to discharge—that is to say, the efficiency —will be the same in both instances. As on discharge so on charge, the strength of acid for corresponding periods will always be greater in the former than in the latter case, so that the back E. M. F. and the charging E. M. F. required to overcome it will also be larger.

The conditions that exist in a cell plentifully supplied with acid, but in which, owing to a poor disposition of the parts or insufficient porosity of the active material, the diffusion is more or less impeded, may be represented in an exaggerated form by supposing that the containing vessel for the smaller quantity of acid is of a porous nature and allows a certain amount of diffusion to take place between the two liquids. Assuming that the rate of diffusion is very slow, the discharge will reduce the strength of the solution in the inner vessel to practically the same degree as before, and the same amount of energy will be given out electrically, while by leaving them until the solutions in both vessels are equalized, the same amount of heat will be liberated, only more slowly. On proceeding to charge, however, the conditions are different. The strength of acid in the inner is now the same as that in the outer cell to begin with, and, moreover, it concentrates rapidly, so that by the time the charging is completed it is considerably the stronger of the two. On leaving at rest equilibrium will again be restored by diffusion, and a further quantity of heat generated, this time at the expense of the solution in the smaller vessel, which proves that more work has been done than would have been necessary if there had been free communication between one and the other. Imperfect diffusion, therefore, means a loss of electrical energy both during charge and discharge by the direct production of heat, and, consequently, a reduced efficiency, which makes itself apparent in an unduly low E. M. F. when discharging and an unduly high back E. M. F. when charging. No account is, of course, taken in the above examples of variations of internal resistance with changes in the strength of acid, as this would only complicate matters; also, the rate of charge and discharge is assumed to always be the same. It would always approximate more nearly to the conditions that actually exist in practice if diffusion through the porous pot were supposed to be constantly taking place during charge and discharge, although not with sufficient rapidity to maintain equilibrium, but it would not then afford such a good illustration from a theoretical point of view.

Curve *b*, Fig. 1, was calculated on the extreme assumption that the quantity of electrolyte employed is so large, and the rate of equalization of strength by diffusion so rapid, that no sensible weakening is produced during discharge, either in the bulk of free liquid or locally in the portions directly surrounding the active material; and in practice these conditions are very nearly attained in all well-designed cells. The total fall of E. M. F., due to weakening of the acid as a whole, is only about ·05 volt from beginning to end of discharge, and the further loss through imperfect diffusion is not much for reasonable rates of output. The latter loss, however, only appears as a polarization effect, and must be measured accordingly—that is to say, it is not present on open circuit, and is dependent on the rate of working. If a series of curves, showing the variation of E. M. F. with strength of acid, were constructed on the assumption of various limited quantities of electrolyte, they would all be found to lie below curve *b*, the smaller the quantity the less being the E. M. F. for every given strength and the lower, therefore, the corresponding curve, but none of them would fall as low as curve *a*.

(*To be continued.*)



LISTENING FOR FIRST MESSAGE THRO' THE EARTH. THE INCANDESCENT HUMAN LAMP. POWER GENERATED FROM NIAGARA FALLS.

THE TESLAIC THEORY ILLUSTRATED IN THE DAILY PRESS.

ONE LICENSEE WANTS ITS RIGHTS.

The Edison Electric Illuminating Company of Pottsville, Pa., has brought suit for damages against the General Electric Company for violation of contract in selling Edison apparatus in the licensee territory belonging to the former company.

The situation of the Pottsville Company was presented at some length in the issue of ELECTRICITY for October 24 last.

What Are These Assets Worth?

The Chattanooga Electric Light Company, which is now in the hands of a receiver, will be foreclosed by the bondholders on the 22d of this month. It is more than likely it will be bought in by the General Electric Company, which, it is said, holds a majority of the bonds. There is some talk of the city becoming a bidder, but the truth of this could not be ascertained.

The General Electric Company holds, according to the last annual report, $57,000 worth of the bonds of this company.

CURRENT ITEMS.

Mr. George Iles, of Montreal, in a paper read recently before the International Congress of Charities, Correction and Philanthropy at Chicago on "Popular Education in Social Science," paid this tribute to the electric railroad, coupled with praise of the men whose energy and tact have been exerted in its development: "Within the past three years many of our cities have been doubled in area at a bound by the supersedure of the railroad horse by the electric motor. Has this come about through spontaneous appreciation of what electricity can do in enlarging the boundaries of suburbs, in giving poor men a new chance to own homes? Not a bit of it. The demand for electric transit has followed upon an adroit and thorough education of the people. Mark the principal officer of one of the companies engaged in this field, an engineer of the best training, an accomplished writer and speaker, and withal a gentleman of the utmost social charm. From preliminary advocacy in the press to negotiations with local capitalists, and the securing of franchises, this man is a general in ability, a diplomat in address Is it any wonder that as he goes about the country success attends him? He has a lesson for us In social reform, the end of social science, there has been too much of a passive policy. We live in times of tactful and persistent solicitation, when people scarcely buy shoes or loaves except on request." There is a hint in the last sentence that people who do not advertise their wares ought to consider.

Lord Kelvin is of the opinion that the internal heat of the earth has no bearing whatever upon climates, contending that the intense heat known to have once existed at the surface of the earth was due to a much higher temperature of the sun. The earth might be of the temperature of white hot iron 2,000 feet below the surface, or as cold as ice 50 feet below, without altering the present climate in the least.

All Aboard for Lynn.

Following is a special dispatch, under Lynn date, in the daily press:

It is announced that a large portion of the works of the Thomson-Houston Electric Company which was taken from the Lynn shops and transferred to Schenectady some months ago will be returned to Lynn. This will necessitate the employment of many men beyond the present pay roll of the company, which is about eighteen hundred. Three years ago the number employed was 3,000. The general work here will be greatly increased.

Is the land syndicate to get the Schenectady works?

Will the Pennsylvania General Electric Be the Next?

We learn that the General Electric Company has at last succeeded in purchasing the outstanding shares of stock in the Pennsylvania G. E. Company which they have been after so long.

The next announcement will be, we take it, that the affairs of the Pennsylvania Company, like that of the Northwest G. E., will be wound up and the offices closed.

New York Electrical Society.

Thorough Discussion of the Conduit Question.

As announced in the last issue of this paper, the New York Electrical Society held its regular meeting at Columbia College on the evening of November 1st. The paper of the evening, by Mr. Joseph Sachs, was one of unusual interest and drew out a large audience of representative electrical men. Mr. Sachs, who has given the subject a great deal of attention, propounded the question "Is There a Solution of the Electric Conduit Railway Problem." The lecturer made free use of the lantern, throwing diagrams of the different conduit systems upon the screen, and explained the apparent shortcomings and merits of each. In conclusion he enumerated what in his opinion were the essentials to a successful conduit system, and stated it as his conviction that they were all at hand to the engineer and only required the proper assembling, with enough money to insure first-class work, to give us the successful working electric conduit road.

The paper was followed by a very full discussion, which we believe will form the most valuable contribution to the literature of the electrical conduit road and its practicability thus far made. In fact, so complete and full was this discussion that any attempt to epitomize it here would do it but scant justice. We will, however, give the stenographic report of the same in future issues. Among those who took a prominent part in the discussion may be mentioned Messrs. Wolcott, Fairchilds, Mailloux, Lundell, Field, Stetson and Merrill.

Personal.

Mr. H. Ward Leonard expects to sail this week and will spend two or three months abroad. Mr. Leonard has taken a contract for building for the Johnson Company of Johnstown, Pa., an electric locomotive for their electric welding work which will be a complete central station plant on wheels, thus doing away with the use of the trolley current in the welding operation. The chief object of the trip abroad is to make a close investigation of the Heilmann locomotive.

Mr. Charles Desmond, of Chicago, was a New York visitor last week. Mr. Desmond returns to Chicago to assume editorial charge of the *Stationary Engineer*, with which he was formerly connected.

Mr. James H. Rhotehamel, president of the Columbia Lamp Company of St. Louis, is in New York this week.

LEGAL NOTES.

Mr. Walter K. Freeman, who was quite prominent a few years ago as a professional affidavit-maker for first one side and then the other in the Edison-Sawyer Man lamp litigation, has brought suit at Racine, Wis., against the Westinghouse and T.-H. companies, alleging priority of invention for the transformer system.

In Brooklyn, John P. Persch has secured an injunction restraining J. W. Allison from transferring two notes of $10,000 each given by the plaintiff to Allison. It is stated that notes were given for the transfer by Allison of his license to introduce the Strowger automatic telephone system in to Pennsylvania. The statements as to the absolute secrecy with which communication could be made by the new system and as to the patents held by the company were false, and the plaintiff wants his notes returned.

Boston Notes.

The New England Telephone and Telegraph Company has begun the work of placing all its wires underground in Lynn. The undertaking will require considerable time, as the company has many wires in the Shoe City, but work is to be pushed right along until the job is completed.

The city of Newton has declared in favor of a municipal electric light station, and the Newton and Watertown Gas and Electric Lighting Company hopes to be able to sell its entire system to the city. The citizens, however, do not wish to purchase the gas and electric light plants—only the latter—and will petition the State Legislature at its next session for authority to purchase the electric light plant alone, the city having no use for the gas plant.

A strong syndicate of capitalists and railway men are seeking permission from the City Council of Gloucester for the right of way for a new electric railway that is to connect Salem with Gloucester by way of intermediate towns along the North Shore. The entire property is a big one, and if the necessary powers are granted work will begin in earnest next spring.

In view of the development of the electric railway system throughout New England which is now taking place, and which promises to become more flourishing in the near future, several new electric railway supply companies have been organized, and all report themselves busy filling orders. It would appear as if business was actually reviving.

The Pettingell-Andrews Company, the Thompson-Brown Electric Company and the recently incorporated Anchor Electric Company may consider themselves three of the foremost supply houses in the country. Each company has handsome sale quarters in Boston, with every facility for handling with promptness all orders entrusted to them to fill. Boston is entitled to rank as one of the foremost electrical cities in the Union and is the centre of the railway systems of New England.

Last week we announced the opening of the new store of the Thompson-Brown Electric Company. This week we have to chronicle the advent of a strong combination under the title of the Anchor Electric Company, the principals in which are well known electric supply men, electrical engineers and manufacturers. Mr. H. C. Hawks of the Hawks Electric Company is president, Mr. P. M. Reynolds treasurer, and Mr. Norman Marshall, of the Iona Manufacturing Company, vice-president and secretary. This new company will handle every kind of railway and lighting supplies, and manufacture quite a variety of electrical specialties, they having splendid manufacturing facilities. The new store, which is one of the finest in Boston, is at 71 Federal street, right in the midst of a district where the leading electrical firms are locating. There are unmistakable indications that trade is reviving in and around the Hub.

The employees of the West End Railroad were in a somewhat ruffled, not to say belligerent, mood the past week, over some supposed grievances. There was talk of tying the entire system up on Saturday, but the directors expressed their willingness to meet the men for conference and to modify certain rules that were complained of by the men. Some time ago an agreement was made between the company and its men that was to be operative for a year at least, but the latter complain that it is being violated right along and they insist upon its being respected by their employers as well as by themselves.

General News.

What is Going on in the Electrical World.

Garden City, Kan.—The business men and citizens are considering the question of putting in an electric light plant here.

San Francisco.—Adolph Sutro has asked the supervisors for permission to use an electric trolley system on his proposed ocean beach railroad.

New York.—The Edison Electric Illuminating Company of New York has declared a quarterly dividend of 1½ per cent. It was payable November 1.

Cuthbert, Ga.—Surveys have been made for the proposed waterworks and electric light plants which the people of this town are anxious to have put in operation.

Oswego, N. Y.—The commissioners of public works are not satisfied with the bids for the electric light contract opened on the 25th and will invite new bids.

Meriden, Conn.—Under the management of L. V. Walkeley, of Southington, the building of an electric road from Meriden to Southington is probable at an early day.

Manitowoc, Wis.—A committee of citizens have visited Milwaukee to get data for a report on the advisability of establishing a city electric lighting plant in this place.

Plainville, Conn.—The Plainville Electric Light Company has sold out its charter to the Tramway Company, and the prospect for electric lights seems good in this village.

Cleveland, Tenn.—Lucius Mansfield, a local electrician, has been awarded the contract to equip a cotton mill at Cleveland, Tenn., with electric lights. About 400 lights will be strung.

Atlanta, Ga.—Electricity will be a big feature of the Exposition soon to be opened here. The electrical building will contain a fine display of all that is new and interesting in electrical apparatus.

Cleveland, O.—The right of way from Cleveland to Chagrin Falls, via Randall, has been secured for the proposed electric street railway and work is to begin on the Randall division immediately.

Peoria, Ill.—The city council has declared the rights, privileges and franchises of the Central Railway Company forfeited, and instructed the company to remove all its tracks, poles, wires, etc., from the streets.

Muncie, Ind.—The receiver of the Muncie Electrical Works has sold it to W. S. Richey and Albert Richey of Muncie, R.F. Platt of Chicago, and C. W. Brown of Jacksonville, Ill., who will put the factory in full operation.

Elkhart, Ind.—On the night of the 30th ult., the six-foot balance wheel at the new electric light plant in this city flew into pieces, badly damaging three dynamos and the buildings. None of the employes was injured.

New Britain, Conn.—The Central Railroad and Electric Company has bought the franchise of the Plainville Light Company, and will supply that town with electric arc lights and incandescent lamps. The company will put in a new dynamo.

Austin, Tex.—The National Telephone Construction Company are making arrangements for putting in telephones of their manufacture here, and another company has been soliciting subscribers. The Bell Company, therefore, will soon have two rivals in this field.

Richmond, Va. Maurice W. Thomas, representing the Old Dominion Electrical Construction Company, has been requested by a committee of the city council to submit a detailed estimate as to the cost of establishing a municipal electric lighting plant, operated by water or steam power.

Flemington, N. J.—Mr. Karr, a Hackettstown electrician, has been asked to submit to the board of trustees estimates of the cost of establishing an electric light plant in this town. Arc lights of 1,200 candle power are to be used. From 40 to 50 lights will be required.

Detroit, Mich.—The lighting commission has authorized the drawing of their voucher in the sum of $63,000 in favor of the Peninsular Electric Light Company for 120 towers, at $525 each. The remaining sixteen towers are not complete, and will not be paid for until the missing parts have been furnished.

Washington, D. C.—Experiments were made at the recent rifle practice at Fort Clark, Tex., with the field telephone equipment for the army which proved its usefulness in military operations, and prominent army officers have recommended that every military post be furnished with a telephone equipment.

Orange, N. J.—The Suburban Traction Company has asked for a settlement from its creditors on the basis of fifty cents on the dollar. The accident at Eagle Rock, in which nearly a score of persons were injured, and for which suits for damages amounting to $172,000 have been brought, necessitated this action.

Ballston, N. Y.—Frederick B. Barnes, representing the Boston Construction Company, has received from the trustees of this village a franchise for an electric road from Ballston to the village line. He will deposit $50,000 as a guarantee that the road will be built and in operation not later than August 1, 1895.

Montreal, Can.—The *Witness* says: "Canadian securities are the favorite at present in the London market, judging from the success of recent issues. Mr. David Morrice returned from England on Monday, and announces the provisional sale of $750,000 bonds of the Royal Electric Company of this city at a good figure."

Syracuse, N. Y.—The postoffice is now lighted by electricity and the employes are all pleased with the change from gas. The plant was put in by the Syracuse Electric Light and Power Company free of expense to the Government, the company holding title to the property. The Government pays rental for the light.

Attleboro, Mass.—A new stock company has been organized under the name of the Attleboro Steam and Electric Company with a capital of $65,000. The stockholders include William H. Haskell, of Pawtucket, R. I.; Homer M. Daggett, Jr., of Attleboro; T. I. Smith, of North Attleboro, and William A. Welton, of Providence.

Alexandria, La.—The Southern Electrical Manufacturing and Supply Company of New Orleans, to whom the contract was awarded by the city council of Alexandria, has executed a bond in the sum of $5,000 to commence the erection of electric lights and waterworks within thirty days, and push the work to completion as soon as possible.

Albany, N. Y.—President Chauncey M. Depew of the Central Hudson River Railroad said to a *Times-Union* representative the other day that he expects the Vanderbilt roads will be carrying passengers between Albany and New York City in less than two hours before the close of the year 1895, and the motive power will be electricity instead of steam.

Indianapolis, Ind.—N. F. Clodfelter, promoter and general superintendent of the Indianapolis, Marion and Anderson Electric Railway, says the equipment of the road will be of the finest quality, the company expecting to spend about $15,000 a mile on track and equipment. George F. Huggins, of New York, is general manager of the company.

Charleston, S. C.—The city council has granted to Julian Fishburne the right to build and operate an electric street railway in Charleston extending "through King street from the city limits to the Battery, and portions of other streets to circumvent the city and approach the business centres, wharves, railroads, ferries, pleasure grounds and residence portions of the city."

Toledo, O.—The mayor has notified the electors of the city of the fact that the Toledo Electric Railway Company and the Toledo Consolidated Electric Company will ask at the November election the right to enter into contract with the city for public lighting. The Central Chandelier Company, another applicant for the contract, will be on the official ballots under the sheriff's proclamation.

Akron, O.—Electric railways are a topic of much conversation here. What with two lines under way between Akron and Cleveland, two lines already built to Cuyahoga Falls, one to Barberton, a company organized to build between here and Canton, and prospects of a line to Kent and Ravenna, Akron is soon to be an electric railway center of no little importance.

Hackensack, N. J.—George S. Forbush, of Brookline, Mass.; Francis L. Callanan, of New York,; Otis G. Burnap and Frank Gardner, of Brooklyn, and several wealthy residents of Rutherford, have filed articles of incorporation of the Union Traction Company, with a capital of $1,500,000. They propose to build trolley roads all over the lower end of Bergen County, to connect Hackensack and Newark and many other towns along the Pennsylvania railroad.

Chicago.—A successful test has been made of the new direct overland wire of the Postal Telegraph Cable Company between this city and Albuquerque, N. M. The wire runs through St. Louis, Kansas City and La Junta, Colo., a distance of 1,500 miles. The circuit was made up without the aid of any intermediate battery whatever and was worked duplex for several hours, giving entire satisfaction. The Postal Company expects to reach the Pacific coast in thirty days and be ready for business December 1.

Boston, Mass.—General Francis A. Walker, president of the Institute of Technology, has suggested to the trustees of the Franklin fund (now amounting to $365,000) that the money be applied to the creation of a department of electricity at the Institute. He thinks that in view of the growing importance of electricity to the world and the value of an understanding of its laws this would be a proper use to put it to, and would be a decidedly appropriate application when Franklin's interest in and investigation of electrical phenomena is remembered.

Elizabeth, N. J.—The Elizabeth Mutual Telephone Company has completed its organization by electing the following directors: F. M. Voorhees, J. M. Groeff, Peter Egenolf, L. R. Brown, George C. Ford, George A. Ford, James Oakes, J. W. Whalen, Charles H. Moore, W. H. Rankin, R. M. Waterbury, W. A. Clark, C. A. Trimble, Charles McArthur and William Finck. The company will at once advertise for bids, and the construction of the line through the city will be begun. More than 300 subscribers have been secured and $30,000 raised.

Ottawa, Can.—It is stated that a company, mostly composed of Ottawa capitalists, has been formed for the purpose of building an electric railway to connect Ottawa and Brockville. The financial arrangements are said to have been completed and a charter is to be applied for at once. The power will be water throughout, beginning with the falls at the Chaudiere, then drawing upon the falls of the Rideau River at Manotick, and thence at different points of the river route up to a point nearly twenty-five miles from Brockville, where steam will be used.

Cincinnati.—The Supreme Court has affirmed the decision of the Superior Court in the suit of the city against the Cincinnati Inclined Plane

Railway Company (Mt. Auburn Electric Railway). The effect of the decision is to forfeit the franchise under which a portion of the road is operated. This leaves the road absolutely without the right to operate. If it cannot get another franchise it must cease business. That franchise will be the subject of competitive bidding, no doubt, as it is now the rule to require such bids for franchises. The portion forfeited is from the inclined plane down into the city and one track of the portion on Mt. Auburn.

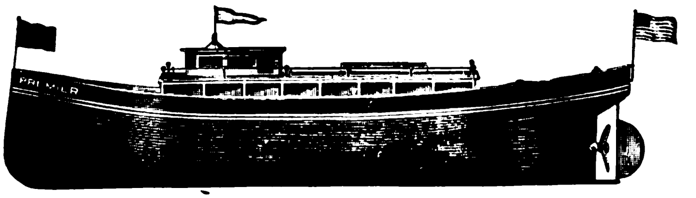


Fig. 1.

Bennington, Vt.—The bill to incorporate the Bennington and Woodford Electric Railroad Company, now before the Legislature of Vermont, names Wm. J. Turk, C. W. Crispell, C. E. Keefe, John Robinson, Amos Aldrich, C. H. Mason, D. A. Gorton and H. W. Martin as incorporators. By its terms the capital stock of the company may consist of not more than $200-000 and not less than $10,000. The proposed line is to run from some point in the village of Bennington, easterly through Bennington, Woodford, Glastenbury, Dover, Somerset, Searsbury and Wilmington. The Bennington and Woodford Construction and Improvement Company is also asking for a charter. The persons named as incorporators are W. J. Turk, C. W. Crispell, C. E. Keefe, John Robinson, D. A. Gorton, Amos Aldrich, L. W. Winchester and H. W. Martin. The capital stock is placed at not over $300,000 and not less than $10,000. The purposes of the company are to build electric railroads, telegraph and telephone lines, hotels and other structures. There is also the application for a charter for the Bennington Electric Railroad, which is to run from Bennington to Walloomsac, via North Bennington.

A New Firm.

The firm of Metcalfe & Moeller, electrical engineers, just started in business at 343 Ninth avenue, New York, will make a specialty of repairing all kinds of electrical machinery and rewinding dynamos and motors of all makes. It affords us pleasure to commend the new firm to all who use electrical machinery, and to the trade generally, because we feel confident of their ability to give thorough satisfaction in all they undertake to do. Mr. G. R. Metcalfe, M. E., the senior partner, was formerly an editor of this paper, and has had a great deal of practical experience in electrical work, having been connected at various times in past years with the Edison United Mfg. Co., the Daft Elec. Co., the Sprague Elec. Ry. and Motor Co. and the Edison General Elec. Co. Mr. F. Moeller, the other partner, is highly endorsed by all who know him. He is a graduate of the scientific department of the University of New York. We wish the new firm a successful and prosperous career.

The Rae Electric Company.

The Rae Electric Manufacturing Company, Limited, has been organized at Detroit. The objects of the corporation are the manufacture of various electrical working devices, dynamos, motors, etc. The stockholders are Frank B. Rae, F. H. Date, John Heffron and B. H. Scranton. F. B. Rae is chairman of the corporation, with F. H. Date as secretary and B. H. Scranton as treasurer.

The Wallace Electric Company.

The Wallace Electric Company, 307 Dearborn street, Chicago, have issued a neat catalogue, illustrating their complete line of overhead railway supplies, all of which have been on the market for some time and proved to be satisfactory through extensive use.

The Wallace Company also announce that they are prepared to sell a new incandescent lamp, the "Brilliak," which is claimed to be of a high standard of excellence.

Contract for Standard Cable.

The Board of Fire Commissioners of New York have awarded the contract to lay fifty miles of wires of the department underground to the Standard Underground Cable Company for $28,959.51. The work must, the contract provides, be done in 100 days. The territory covered is south of 130th street.

The Hart & Hegeman Company.

The Hart & Hegeman Company of Hartford are doing the best business in their history. In one day of last week orders were received for over 2,500 of the well-known Hart switches.

The Miniature Electric Yacht.

The cut Fig. 1 illustrates a new model miniature Electric Yacht devised by M. R. Rodrigues, length 26 inches, beam 6½ inches, finely finished and coated with six coats of hard paint and lastly with ship varnish, making a boat that will stand hard boy-service as well as being an ornament to any parlor.

The motive power consists of the Rodrigues No. 1 Premier Motor, geared, not belted, to the shaft holding the propeller or screw. Every size of two and three blade screws has been tested with the result that the two-blade screw of 2¼ inches diameter has been decided on as giving the best results.

The battery is the special cell made expressly for Mr. Rodrigues and used for the boat only. The batteries are not sold separate. There is no glass jar and when the cell is once charged it will run the boat at a speed of about three miles an hour at a cost of one cent per hour. One charge of five ounces of electropolon solution will last from one to two hours.

The motor and battery can be taken out of the boat in an instant and the boat cleaned thoroughly inside and outside without trouble. There is nothing that will corrode by the action of water, all the internal parts being well protected with paint. A switch on the stern deck opens and closes the circuit.

Mr. Rodrigues also makes the same boat without the cabin top, and sells the motor and bracket with screw shaft complete so that any boy can fit it to any boat with little trouble.

Cut Fig. 2 represents the motor, on bracket with screw, ready to be put in boat. To do this the propeller is taken off the shaft, a hole is bored through the stern in the proper place, and the propeller shaft inserted and made watertight. The screw is now put on, and when the battery is put in the boat is ready for business or to be put into commission.

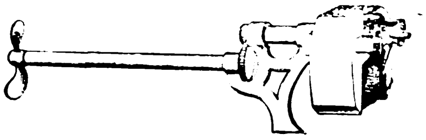


Fig. 2.

INCORPORATIONS.

The Hunterdon Electric Company, Lambertville, N.J.—to manufacture, generate and store electricity for light, heat and power and traction power. Capital stock, $30,000. Promoters: Wm. B. Bratten, Lenni, Pa.; W. Alex. Robinson, Geo. W. Jacobs, Jr., Philadelphia.

The Marble City Water and Power Company, Marble City, Colo.—to construct a ditch and reservoir for water power to furnish electric light to the town of Marble City. Capital stock, $100,000. Promoters: Robert Hays Kline, Philadelphia, Pa.; Wm. W. Wood, Alexander J. Mitchell, Marble City, Colo.

The Rae Electric Manufacturing Company (Limited) has filed articles of association with the register of deeds at Detroit, Mich. The capital stock is $2,000, and is held by Frank B. Rae, Benjamin H. Scranton, John Heffron and Frederick H. Date.

The Power Development Company, San Francisco, Cal.—to generate, produce and develop water and electric power; deal in water rights; build and operate water and other works, mills, factories, machinery; transmit light and power for all purposes. Capital stock, $500,000. Promoters: Albert Miller, Edw. W. Hopkins, Chas. A. Grow, Chas. Webb Howard, San Francisco; Carroll N. Beal, New York City.

The Cleveland and Elyria Electric Railroad Company, Berea, Ohio—to construct, maintain and operate an electric railroad between Cleveland, Elyria, Wellington and Oberlin, furnish electric light, heat and power, etc. Capital stock, $200,000. Promoters: E. T. Pomeroy, Berea; M. A. Sprague, A. W. Bishop.

The Columbia, Ironville and Mountjoy Street Railway Company, Philadelphia, Pa.—to construct, maintain and operate an electric railway. Capital stock, $300,000. Promoters: W. N. Boyer, Sam'l R. Russell, Anthony H. Dillman, Philadelphia.

The Capital Electric Company, Springfield, Ill.—to produce and furnish electricity for light, heat and power, and furnish electrical applications and electrical discoveries. Capital stock, $60,000. Promoters: Jno. McCreary, Peter W. Harts, Fred. H. Buke, Geo. Pasfield, Edwin A. Wilson.

The Salina Telephone Company, Salina, Kan.—to construct and operate a line of telephones in Salina and in other cities of Saline County. Capital stock, $10,000. Directors: D. A. Van Trine, Ira S. Van Trine, A. M. Campbell, J. O. Wilson, all of Salina, and R. H. Allerton, of Kansas City, Mo.

The Pioneer Electric Light Company of Barnet, Vt., Barnet, Vt.—to furnish light and power at Barnet. Capital stock, $3,000. Promoters: H. E. Wilson, W. H. Burbank, Sherburn Moore, E. E. McGaffey, H. A. Gilfillan, Barnet.

Attleborough Steam and Electric Company, Attleboro, Mass.—to produce, use and generate electricity for light, heat and power; manufacture and deal in machinery used for the purpose. Capital stock, $65,000. Promoters: Wm. A. Walton, Wm. H. Haskell, Homer M. Daggett, Jr., Theron I. Smith.

The National Electrical Company, Louisville, Ky.—to manufacture and sell electric cigar lighters, electrical devices of all kinds. Capital stock, $20,000. Promoters: Jas. E. Gaither, J. W. Dawson, G. W. Eneby, J. C. Bowan, F. Eneby, J. M. Gilmore, Louisville, Ky.

The Cook Elevated Electric Railway Company, Chicago, Ill.—to manufacture and construct elevated railroads, material and equipments relating thereto; authorize others to construct the same; procure and use patents relating thereto. Capital stock, $10,000,000. Promoters: Mark Sands, James E. Gaule, Carl H. Leopold.

Tyee Consolidated Mining Company, San Francisco, Cal.—to do a mining and milling business; build and operate water works, electric light and power systems, steamboat lines and ferries; deal in merchandise. Capital stock, $10,000,000. Promoters: Maurice E. Griffin, Wm. B. Waycott, Richard F. Lewis.

The Mount Gilead Electric Light and Power Company, Mount Gilead, Ohio—to build and operate electric light and power plant. Capital stock, $15,000. Promoters; T. J. Carmack, Cleveland, Ohio; E. T. Bowen, M. J. Carmack.

The American International Electric Company, Hawthorne, N. J.—to manufacture, sell, lease and deal in electrical and other mechanical machinery and appliances. Capital stock, $200,000. Promoters: Henry B. Oakman, Frederick A. Bellvue, Brooklyn, N. Y.; Frank M. Ashley, Hawthorne.

The Anchor Electric Company, Portland, Me.—to carry on an electric lighting, heating, telephone, telegraph and railway business. Capital stock, $7,000. The officers are: President, J. W. Thompson, New York; treasurer, G. H. Haulenback, New York.

Articles of incorporation of the Paragould Electric Light Company have been filed with the Secretary of State at Little Rock, Ark. The capital stock is $5,500, all but $175 of which is paid up. The incorporators are T. H. Wyse, D.A. Bertig, Richard Jackson, Simon Jacobs and T. B. Kitchens.

Chappaqua Electric Light and Power Company—to carry on operations in the towns of New Castle, Bedford and Mount Pleasant, and the village of Mount Kisco, Westchester County. Capital stock, $30,000. Directors: Frank B. Selleck and Bertha G. Selleck, of New York City, and John S. Quinby, of Chappaqua, Westchester County, New York.

Grand Island Electric Land Company of Buffalo—to deal in real estate, etc. Capital stock, $20,000. Directors: J. L. Van Buren and J. Q. Baker, of Dunkirk, and Charles W Holland, Jr., of Buffalo.

The River Telephone Company, Tomahawk, Wis. Capital stock, $2,000. Incorporators: William H. Bradley, of Milwaukee; John Landers, of Merrill, and F. H. Woodworth, of Tomahawk.

The Badger Telephone Company, Poy Sippi, Wis. Capital stock, $2,000. Incorporators: H. A. McWayne, B. A. Barr, W. E. Carpenter, John Boyson and Jonathan Montgomery.

The Eureka Electric Manufacturing Company, St. Louis, Mo.—to manufacture and deal in electrical appliances, etc. Capital stock, $30,000. Promoters: Alfred Bevis, C. H. Longstreth, Daniel W. Smith, all of St. Louis.

New Utrecht Hygiene Ice and Manufacturing Company—to manufacture and deal in artificial and natural ice, electrical or gas appliances, lamps, etc., in the Thirtieth Ward of Brooklyn, N. Y. Capital stock, $225,000. Directors: Harry W. Hatch, Hector M. Hitchings, Albert E. Lazzaro, Frank Muehlfeld and William A. Powell, of New York City.

Cook County Electric Railway, Light and Power Company, Chicago, Ill. Capital stock, $500,000. Incorporators: Clarence N. Durand, Abner T. Young and Charles Greenwood.

A certificate has been filed at the office of the Secretary of State at Springfield, changing the name of the Star Electric Lamp Company of Chicago to the Sunbeam Lamp Manufacturing Company.

The National Electric Reminder Company, Chicago—to manufacture electrical devices. Capital stock, $250,000. Incorporators: Siegfried Rosenfield, August Binswanger, David C. Thoms.

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EDITORIAL NOTES.

Science or Fraud?

This is the question very pertinently asked by a Pittsburg daily paper in reporting the recent attempt of "Dr." J. Allen Hornsby to organize in that city a branch of the National School of Electricity of which he and "Prof." J. P. Barrett, of Chicago, were the founders. There was a preliminary meeting at which Mr. Hornsby was present, and he seems to have been questioned rather severely, but from his replies we take it that he was not embarrassed in the least. His motto for the evening was evidently the old one, that "A lie well stuck to is as good as the truth."

For the first time in the brief career of this organization, the prospective students decided to make a thorough investigation before contributing their money to the philanthropic promoters, and a committee was appointed for that purpose. It was stated to Mr. Hornsby that both Edison and Tesla had disclaimed any connection with the school and had forbidden the use of their names, but he denied this stoutly and at some length.

We are convinced that the Pittsburg boys have made a move in the right direction, and that a thorough investigation from other proposed branches will substantiate all the charges made in these columns and save a great many ambitious young men from wasting their money.

Our opinion of the whole scheme of this National School of Electricity, published when the organization was first announced, has been fully confirmed.

The promoters were shrewd enough to secure the co-operation of two or three good and honest men, like Profs. Shepardson and Thomas, and the scheme of popular education on the lines proposed is sensible and praiseworthy within certain limits; thus the evil was mixed with enough good so that the public generally, and those men whose names were used without warrant, disliked to make serious criticism of the school as a whole.

ELECTRICITY has already pointed out the good and the bad. Our main contention is that no enterprise of this nature should be allowed to sail under false colors, and that it is the duty of the technical press to point out the fraudulent misrepresentations made, in order that intending students may be better able to estimate the probabilities of their securing what is promised them.

The chief promoters of the school have from the first made false and fraudulent claims. A letter over the autograph signature of J. A. Hornsby, dated November 5, shows that they still use the names of Edison and Tesla as the heads of the faculty, though *both of these gentlemen have distinctly denied any connection with the school and requested that the use of their names be stopped.* That they have not made their position in the matter more public may be assumed to be due to their kindly feeling for Prof. Shepardson, Prof. Stine and the others, who have not been so quick to realize the unfortunate position they are placed in as associates of men like Hornsby.

Another fraudulent claim is that the project is philanthropic. It is intended to be a money-making scheme and nothing else. The intentions of the exemplary professors last mentioned are no doubt philanthropic, *but they do not handle the cash.* If the branches so far projected are all finally organized, Hornsby and Barrett will make more money yearly than they could at honest labor in ten years.

The third fraudulent claim is the most reprehensible of all, and has therefore been made with more caution. It is that young men having slight previous knowledge of the subject can become proficient enough in electrics during the brief course of study to enable them to secure positions as engineers or practical electrical mechanics. *Not one out of five hundred can do this.*

It is only a matter of ten or twelve years since New York (and possibly other cities) was cursed with so-called telegraph schools in large numbers. During the administration of Mayor Hewitt they were all closed up as frauds upon the public, being placed upon the same basis as the green-goods business, except that the profits in the telegraph schools were not large enough to warrant the payment of sufficient money to the police to secure protection. The teaching of telegraphy in this way was, of course, simplicity itself in comparison with the task assumed by these schools of electricity.

The weak spots in this scheme are pointed out for the public benefit, and we recommend the appointment of other committees of investigation like the one at Pittsburg, and they should begin their work on the recent record of J. A. Hornsby, the guiding spirit of the enterprise. It will be found that there is no truth in him and that he does not possess enough intellect to conceal his chief weakness, which is falsifying.

His blatant and impudent defence of the electrical quacks who disgraced the entire electrical department at the Fair by their presence, in an attempted reply to the severe castigation administered by Prof. Sylvanus P. Thompson at the official banquet last year, was sufficient to characterize him as ignorant. ill-bred and void of all moral sense. His misstatements at Pittsburg show that his sense of truth has not improved during the past year.

If the National School of Electricity is to retain any measure of public confidence it must drop some of its men and change its methods.

* * *

Is There a Short Cut to Knowledge? The activity of the various so-called schools organized as commercial undertakings for the purpose of teaching electrics, mining engineering and other branches of science by correspondence methods or by weekly evening classes, in various communities, and the partial success which some of these schools have achieved, gives conclusive proof of the existence of a widespread thirst for knowledge among the thousands of young men who either did not have, or failed to take advantage of, early opportunities for education.

We hold that this army of young men is entitled to all the information possible from men of education who are qualified to give intelligent opinions and whose views would be of value as to the probability of their getting what they pay for from these schools. The subject is worthy of full discussion before the American Institute of Electrical Engineers, whose membership embraces many proficient electrical engineers who have had the benefit of college training and others equally proficient who have had no such advantages—self-educated men.

The benefits of study, the desirability of *any degree* of education on any subject, are so far beyond dispute that thinking men always have the greatest hesitancy in condemning off-hand any educational project. Yet it must be admitted that there are many weak spots in all these schemes, which are made distinctly commercial matters by their promoters. Would not a full discussion result in the formulation of some plan by which a reasonable understanding of the elements of electrics could be secured at small cost by the young men in all our cities?

Some few points may be regarded as settled in advance:

No one is justified in expecting that he will be fitted to obtain employment as an electrical engineer by a course in any of these schools.

Every mechanic engaged in an electrical workshop should be justified in expecting that he will be better fitted for his present position by the course, that he will know more about his business, and that he will acquire a foundation upon which he can build by personal effort a solid technical education, the degree of which will depend entirely upon the earnestness and the length of time in which he applies himself; and that any school which makes even the slightest misrepresentation is unworthy of any confidence—*falsus in uno, falsus in omnibus.*

The idea of the Brooklyn Electrical Society in taking into membership any young man who is interested, holding weekly meetings of a rather informal nature where even the most elementary discussions may be carried on without any embarrassment, always attended by some one or more men of high attainments in the science, giving an entire winter's schooling at insignificant cost and no pecuniary profit to any one, must be commended without reservation. The Brooklyn Edison Company opens its parlors free of charge for those meetings, and Mr. Barstow gives the use of all the station testing apparatus. There must be a hundred other central stations which would cheerfully perform a like service to the cause of popular scientific information if the matter were brought to their attention. There is, we believe, a club of this nature in Chicago.

In no branch of industry is there greater need of knowledge, and the men who have worked their way to the front without early advantages, of whom there are many, should be and are anxious to make the path easier for similarly situated young men just entering the business in humble positions.

ELECTRICITY extends the right hand of fellowship to every enterprise and every society which conducts its affairs intelligently and honestly.

* * *

The Point of View. We note the difference of opinion existing in the sanctums of our contemporaries, the *Electrical Engineer* and the *Electrical Review*, as to the success or non-success of the Railway Convention at Atlanta. The former saw little to commend in the meeting, and the latter cannot find enough fulsome adjectives in the dictionary to express its feelings. There should be no controversy, as it is simply the result of looking at things from a different point of view. The editorial mind of the former cannot interest itself in anything less than higher mathematics, hysteresis, electrical resonance or magnetic viscosity, while that of the latter rarely rises above the plane of commercial reading notices and inane jokes. The argument recalls Sidney Smith's story of the two fishwomen forever quarreling from opposite sides of the fence which separated their back yards—they never came to an agreement, because they always argued from different premises.

ELECTRICITY, standing upon a higher eminence than either of these esteemed contemporaries, is thus able to take a broader view of things. Hence our report of the Convention revealed a keen appreciation of the business and social sides and our regret that the proceedings proper were not of a more educational character.

* * *

Rapid Transit for New York. Not the least welcome result to New Yorkers of the recent election was the large majority cast for the pledging of the city's credit in the great rapid transit scheme which for several years past has engrossed public attention. It will be remembered that a Rapid Transit Commission was appointed to devise ways and means for accomplishing this much-desired result, and that after spending much time and money in drawing up plans and specifications their labors came to naught by reason of the inanely foolish "safeguards" within which they hedged the franchise. It will be remembered how after all this labor this Commission put up the franchise at public auction, and how no one would have it as a gift as it stood because of the burdensome requirements and restrictions by which it was hedged about (we believe there was one bid of a few thousand dollars, which only served to emphasize the ridiculousness of the plan), and how this same Commission wrote themselves down as asses by abandoning their plans at once at this this first rebuff. We cannot go into the history of this rapid transit project at this time, but it is all too recent for anyone to have forgotten how the hope of its fulfilment became so long deferred as to make the New Yorkers heart sick until the plan was crystallized of building the road at the city's expense and leasing it to private parties to construct and operate under certain conditions which should relieve the city of the burden of additional taxation. We believe it was ex-Mayor Hewitt who first evolved this scheme, and although it was strongly opposed by some at the time, it gradually grew in favor until it resulted in the necessary legislation, leaving the question open to the people. The people answered in the affirmative at the recent election by a majority of nearly 70,000 votes, and it is now, according to the letter of the law, mandatory upon the Commission to begin construction within thirty days after the result of the election is made known to them. This would certainly seem satisfactory, but we see from one of the interviews, published elsewhere, that it is open to another interpretation.

Those who try to harmonize the teachings of the Bible with those of science tell us that we are not to interpret the six working days of creation as meaning six ordinary days of 24 hours each, but as periods of time, and they adduce as authority for this another Scriptural passage which says "a thousand years are but a day in the eyes of the Lord." Now, from past experience, the average New Yorker has learned to place somewhat the same interpretation upon the days of the Rapid Transit Commissioners, and they will naturally be apprehensive when they read Secretary Delafield's remarks. He says, in referring to the thirty-day clause, "That clause must be read in connection with that part of the act which gives the Commission the right to change or modify the plans or *even to adopt new plans.*"

Under the Searchlight.

Views and Opinions on Timely Topics.

The following has been received from a Cincinnati man of good judgment who has been well posted on electric lighting matters in that city from the beginning of the first station:

"It is the belief in this community that the present management of the local Edison Company, brought about by Coffin, is in the interest of the Cincinnati Gas Company, and that through this interest the Edison plant will eventually be wrecked. We infer that Mr. Beggs is capable of carrying out such a design. The city government is controlled and directed by the gas company, and the company has great influence with the local press, so that much is suppressed, but every action and every occurrence confirm what many believe."

We are inclined to look with skepticism upon this view of the case. Can it be possible that the Association of Edison Illuminating Companies have placed the conduct of their fight with the G. E. Company in the hands of a paid agent of that company?

If it transpires that the Cincinnati Edison station is burned or blown to atoms by an explosion—well, this would be a curious coincidence, as the novelists say.

* * *

A Chicago firm is offering six World's Fair souvenir spoons for 99 cents, and states in the advertisement that the price during the Fair was $9 for the set. We thought last year that things were pretty high in Chicago, but we failed to appreciate the highness of the height.

* * *

Mr. J. W. Aylsworth, who was mentioned recently in these columns as the chemist who left the employ of the Harrison Lamp Works and carried away with him the art of making the special filament which for a time raised the Edison lamp above the rank of the poorest on the market, announces that he is in business for himself and will supply filaments to the trade. We thought he would turn up somewhere. Meantime the Edison people are still making a bamboo filament as in the days of long ago.

* * *

The Wall Street stock market is the first and most reliable index as to general business conditions, and stocks are booming. The building of electric railroads, lighting plants and extensions to central stations will soon be under full headway, and the concerns who are liberal with printer's ink during the next three months will get the lion's share (not the tiger's) of the business for the coming year.

* * *

The troubles and disaffection at the Harrison lamp works are widespread throughout the force, and deep seated. Independent lamp makers could ask for nothing better (or worse) in the condition of their leading competitor's business. Nearly all the best men (not the ornamental kind, but those who know how to make good lamps,) have resigned during the last few weeks, one of the latest to retire being Mr. Ackerman, foreman of the pump department, and the condition of affairs is bordering upon chaos. The trouble dates back to the time when, as we reported, Mr. Upton was treated with discourtesy by his superiors, and men of vastly inferior ability were given higher authority. They have lost the filament process upon which they had spent thousands of dollars, and it does not look as though they had anyone left with enough skill to work it out again. Travelers over the Pennsylvania Railroad a year from to-day will no doubt read that mammoth "To Let" sign which we have predicted, nailed in a conspicuous place on the large factory at Harrison.

We had supposed that the Ferris wheel would hold the wheel record for some years, but must acknowledge our mistake. There has been found in the head of one of the officers of the G. E. Company a wheel ten feet greater in diameter than the Ferris wheel; this wheel is surrounded by other wheels of various sizes, the entire mass of wheels constantly revolving in as many different directions as there are wheels. This officer is the one who says: "I have received an order from Mr. Yerkes for $5,000,000 worth of generators and motors, and the contract will probably run up to $4.000.000 more."

* * *

There appears to be no doubt of a well organized conspiracy in the Harrison Lamp Works against a certain officer in the works who has proved himself too good for his surroundings. Whether this conspiracy succeeds or not it looks as though the business would be wrecked, equally from inside and outside influences. There should be a new committee appointed, Mr. Ord, a committee of investigation. Electricity can supply you with the names of several witnesses.

* * *

We suppose that at the time of the Cleveland Convention of the N. E. L. A., in February, the New York Central Railroad will have an opportunity to demonstrate that they can furnish the finest special train which has been made up. We suggest that they give us the famous engine No. 999, and show us between New York and Buffalo what electrical engineers must do before we can beat steam traction for heavy and rapid railway work. If the record time of the Empire State express could be beaten, the Association would get several columns of free advertising.

* * *

The size of the majorities for the victorious party in the recent election showed that several hundred thousand voters did not have enough change.

* * *

Intending investors will do well to take cognizance of the fact that *valuable* electrical patents are growing scarcer every year. The prospects of commercial success for a new device should be considered apart from the value of the *patent* itself, which nine times out of ten is *nil.* Judge Acheson's decision in the feeder and main case would make a good text book for intending investors.

* * *

After his appointment as assistant to Prof. Barrett, Mr. J. A Hornsby secured the position of foreign representative of the World's Fair Electrical Department by reason of the strength of his claims that he spoke the German language fluently, having been educated at Heidelberg University. After he had gone abroad, a member of his own family, sitting in his office in Jackson Park, unwittingly stated in the presence of some of the World's Fair engineers that Mr. Hornsby had never been abroad, that his knowledge of German was limited to a few stock phrases such as "*Zwei bier,*" "*Bitte giebt mir kartoffeln,*" and "*Bitte um entschuldigung,*" which he had learned while living with a German family at St. Louis; and that his rather narrow English education was received at Heidelberg College, Tiffin, Ohio.

* * *

Long before the G. E. consolidation, Mr. Coffin had come to look upon the Mather Electric Company with special aversion. Every effort was made to drive them out of business. These efforts did not cease after the consolidation. It is therefore with some pleasure that we note the renewed activity of this company, and their continued presence in the race for business. Many of Mr. Coffin's old-time enemies will be here long after he has retired.

If the reported consolidation of electrical interests in Toledo is a fact, it is as plain as a pikestaff that there will be a splendid opening there for a new independent lighting station. The handicap of the "consolidated" company is shown by the following figures. giving the basis on which the local companies were taken in to the $5,000,000 combine:

Consolidated plant	$3,000,000
Robinson's plant	1,400,000
Toledo El ctric Company	350,000
Western Electric Co	200,000
Total	$4,950,000

Who will be the first to let the air of competition into this balloon?

* * *

Was This Wheel Too Strong?

(From the Indianapolis News.)

The six-foot flywheel attached to the machinery of the electric-light plant at Elkhart flew into fragments, a section going through a wall, while other sections were thrown through the roof. Three dynamos were badly damaged. Several persons were imperilled, but Harry Hill was the only one injured and he but slightly.

We advise Mr. Harry Hill and the other people who were imperilled by this accident to consult the editor of the *Electrical World*, who can no doubt tell them whether this foolish wheel yielded to *centrifugal* or *tangential* stress. One thing seems to be certain, that one section of the wheel went off at a tangent, and the editor of the *Electrical World* did the same thing in his recent remarks on the bad habits of flywheels.

* * *

Nothing Small About These Figures.

Has the Press Agent Recovered His Old-Time Buoyancy?

(From the N. Y. Advertiser.)

An officer of the General Electric Company states that he has received an order from Mr. Yerkes, of Chicago, for $5,000,000 worth of generators and motors, and that the contract will probably run up to $4,000,000 more. Yerkes cannot use this amount of machinery in his surface lines, hence it is conceded that it is for the Metropolitan Elevated.

Allowing the price of car equipments of this nature to be about $1,000, Mr. Yerkes is apparently preparing to equip 5,000 cars at once, and 2,000 or 3,000 more in the near future, say by Thanksgiving day.

The full size of this contract can only be taken in by comparison. According to the best statistics available there are only 4,733 cars of all kinds (cable, horse and electric) in use in Chicago, of which the Lake street elevated line has only found use so far for 125.

This was a great contract—if the statements are true.

But we fear the press agent got his figures mixed with those Republican majorities of which we have been reading.

LATER.

Also Slightly Different.

(From the Chicago Journal.)

Charles T. Yerkes, of the West and North Chicago Street Railway Companies, closed a contract in New York City last night with representatives of the General Electric Company for the delivery on or before March 1, 1895, of 600 motors, and generators of 3,600 horse power.

Six hundred motors are required for three hundred cars.

* * *

Well, Well, Well!

Absorptive C. Has Made One More Consolidation.

(From the New York Herald.)

President Coffin, of the General Electric Company, and N. B. Ream, of Chicago, are about to consolidate four electric companies at Toledo—the Consolidated Street Car Company, the Toledo Electric Street Railway Company, the Toledo Electric Company and the Western Electric Company.

Popular Electrical Science.

II.

Speaking Along a Ray of Light.

BY NELSON W. PERRY, E. M.

Communication between distant points by means of flashing lights according to a predetermined code is perhaps the oldest method of telegraphy known, and reaches its highest development in the heliostat by which the sun's rays are reflected in geodetic operations. Especial interest has been excited in this method of signaling by the discovery of several bright spots upon the disk of Mars, and the conjecture of some theorists that this indicated an attempt on the part of the inhabitants of that planet to communicate with us. However pretty this thought may be, astronomers give it no place whatever, and we will doubtless have to ascribe the peculiar and unusual phenomena to some commonplace natural cause and not to the whim of human design. But it is not of this method of signaling that I have to speak in this Paper, but of the utilization of a ray of light, or rather a bundle of rays, for the purpose of communicating articulate speech in exactly a similar manner to that in which we now use a copper or iron wire for the transmission of speech in telephony.

The basis of the first successful attempt to substitute a light ray for the telephone wire depended upon a peculiar property possessed alone in any appreciable degree by the metal selenium. The peculiar property referred to consists in the marked influence which light has upon the conductivity of the metal. It was found that when the metal, which in many of its chemical and physical relations resembles sulphur and tellurium was heated for some time to 100°, and then allowed to slowly cool, it assumed a crystalline form, whose electrical conductivity varied quite materially with the intensity of the light to which it was exposed. Thus in a given specimen whose resistance was 1,200 ohms in the dark, the resistance was but 600 ohms in the daylight.

In the telephone transmitter the electrical resistance of the circuit is varied in consonance with the sound waves of the speaker which set in vibration a diaphragm against which they are directed. There therefore results an undulatory current of electricity in the circuit, which corresponds in every way with the sound waves of the human voice. At the further end this varying current passes through the coil of an electromagnet and causes its magnetism to vary in like manner, and this setting in vibration a second diaphragm in exact synchronism with the one in the transmitter, gives rise to air waves like those produced by the speaker, and we have at the further end an exact, or nearly exact, reproduction of the words originally spoken. In the telephone transmitter the variable current is usually produced by varying the pressure between two contacts, this being done by connecting one of those contacts with the diaphragm which we set in vibration by the voice. It is clear that if we can produce a variable current in any other way it will enable us to transmit speech, and one such other method is at once suggested by the susceptibility of selenium to light. If we could vary the intensity of a light ray to correspond with the sound waves of the voice, we might by causing this ray to impinge upon a piece of selenium placed in an electrical circuit at the distant point vary that electrical current in a similar manner, and cause a telephone to respond as before. This is exactly what Prof. Bell did. He succeeded in transmitting articulate speech by making a beam of light, which a mirror reflects, vibrate, the vibrations being of the same kind as those produced in a diaphragm when spoken to. He used a thin mica or glass plate as a diaphragm, which, by being silvered, served at the same time as a mirror. Reference to Figs. 1 and 2 will make it clear how this was accomplished. The source of light is represented by L, Fig. 2. The rays from this source are rendered parallel by passing through the lens A, and are reflected back from the mirror B to the parabolic reflector D, Fig. 1. The details of the mirror B, which is also the transmitting instrument, are shown in Fig. 3. In this B is a very thin mirror of glass or mica mounted in a wooden frame so as to leave a shallow air chamber D between the back of the mirror and the back of the frame. Leading into this air chamber is a conical speaking tube *C*. The parabolic reflector into which the light rays are reflected has this property, that it will reflect all rays that enter it parallel to its axis to one point, called its focus. It therefore acts as a focussing lens of glass, and might be replaced by such if the latter could be made large enough at a reasonable cost. It will not, however, reflect rays to this point that are not thus parallel to the axis of the reflector. If now the mirror B is a true plane, and it be placed in a proper position, it will reflect all of the parallel rays that it receives from the source of light into the parabolic mirror, and these will there all be concentrated at the latter's focus. If, however, the mirror B be bent outward so as to be convex towards the light, it will disperse the reflected rays so that but few of them will be received by the reflector, and still fewer be concentrated at the latter's focus. If the mirror be bent inward so as to be concave towards the light, the reflected rays will again be thrown out of parallelism, and but few of them be concentrated at the focus. Now, by talking to the mouthpiece *C* the mirror B is set in vibration by the sound waves, so that the intensity of the light received at the focus of the parabolic mirror will vary in an exactly similar manner. If a properly prepared selenium cell be placed at this focus, its electrical resistance will vary as the intensity of the light reflected to it, and if an electric current be passed through this selenium cell it will vary in intensity also, and a telephone placed in this same circuit will respond with the words spoken at the diaphragm *C*. Fig. 1 represents the receiving instrument of such an instrument which Prof. Bell has called the photophone. In this figure, F is an ordinary battery or other source of electricity supplying the local telephone circuit. D is the selenium cell placed in the focus of the parabolic reflector, whose electrical resistance is constantly changing with the changing light intensity with which it is illuminated, and T is an ordinary telephone receiver. It is clear that there is needed no mechanical connection between the transmitter *C* and the receiver D, and that communication could be carried on through space as far as light can penetrate. Were it possible for an inhabitant of the sun to thus vary the intensity of the solar rays as can be done on a small scale in the apparatus just described, he could communicate by word of mouth to his brothers in each of the planets in an ordinary tone of voice. The sun would thus become a grand central photophone exchange, from which verbal messages could be sent through the intervening millions of miles of space just as its luminous rays are now sent to the various worlds which revolve around it. It would labor under this disadvantage, however, as a central exchange, that since the planets tributary to the sun have no light of their own, they could not reply in the same way—they could not talk back and would have to put up with all the insults that this hypothetical solar inhabitant might choose to inflict.

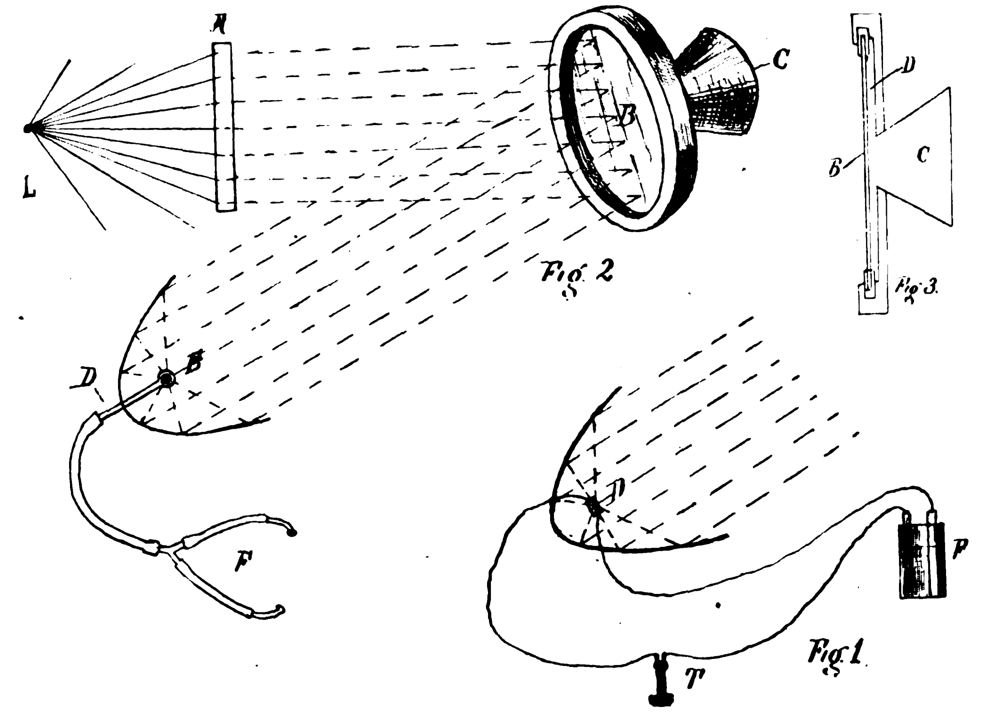


Fig. 2

Fig. 3.

Fig. 1.

An item has frequently gone the rounds of the papers that Mr. Edison was preparing an arrangement by which he expected to be able to hear the roar of the great waves of burning hydrogen in the sun. His plan as thus described was in brief as follows : He owns an extensive tract of magnetic iron ore in New Jersey, and this he proposed to surround by an enormous coil of wire erected on poles skirting its outer boundaries, and the two ends of this coil he proposed to connect with a telephone. It has long been known that periods of great sun-spot activity were also periods of great magnetic disturbance on the earth's surface. It is supposed by many astronomers that these sun-spots are due to gigantic cyclones or other outbursts in the fiery atmosphere of the sun, and it was Mr. Edison's idea, if the newspaper reports are to be believed, that these storms could be made audible in the manner described. His plan was in fact to make a huge electro-magnet of his iron bed, and that the changing magnetism of the latter caused by the solar storms would generate electric currents in the coil which would reproduce in the telephone with more or less fidelity the roar which must accompany such solar outbursts.

Theoretically this should be true, but as a matter of fact, magnetic iron ore, or even large masses of perfectly pure soft iron, cannot change their magnetism with sufficient rapidity to respond to sound waves of the kind expected, and no such results as Mr. Edison is credited with having hoped to attain would be possible. It would seem possible, however, that by a modification of the photophone to adapt it to this particular purpose, these roarings and surgings could be heard. We can see them now with the telescope. How uncanny would it seem if we could also hear them with our material ears!

Bell's experiments and publications regarding the photophone stimulated further investigations, and through these it was found that the transmission of sound through space was possible without using selenium cells and galvanic batteries. It had long been known that when light impinged upon a black or other substance which did not totally reflect all the rays received, the missing rays or those that were absorbed were converted into heat. It was found that surfaces covered with soot were extremely sensitive either to slight variations in temperature (dark heat rays) or to variations in light intensity (which amounted to the same thing). This led Tainter to form the idea of substituting soot for the selenium and Mercadier to give the name of *radiophone* to the instrument thus constructed. Tainter's cell for this purpose consisted of a silvered glass plate from which the silver was removed in a zigzag or circuitous line. The zigzag line being filled with soot was made one terminal of the telephonic circuit, and the silver on the remainder of the glass the other terminal. When intermittent rays of light strike upon the face of such a cell, loud sounds are produced in the telephone.

Still further investigations showed that a thin plate of any material without the zigzag or other marking would give out mechanical sounds, and Bell finally produced an instrument that would respond without the assistance even of the telephone. This instrument as perfected by Mr. L. Richards and Mr. Louis H. Beck, of the American Bell Telephone Company, was exhibited at the World's Fair.

The complete arrangement is shown diagrammatically in Fig. 2. In this, all but the receiving instrument is identical with the arrangement described for the photophone, but the receiving instrument differs. This latter consists of a parabolic mirror as before, but instead of a selenium cell and telephone in a local electric circuit a small glass tube five or six inches long, open at one end and with a bulb at the other, is inserted into the reflector, so that the bulb is exactly in the focus. Into this bulb is inserted a small pellet of burnt cork, and over the open or exterior end of the glass tube is slipped an ordinary rubber hearing tube such as is commonly used on the phonograph.

Prof. Bell's explanation of the action of the radiophone is as follows:

When the variable light beam strikes upon the receiver, the particles are alternately heated and cooled; when they are heated they expand, and consequently the intervals which are filled with air are diminished. When the light is intercepted the particles are cooled and the spaces between them enlarged. Air is squeezed out from the interstices between the particles in the first case and drawn in in the latter; the enlarging of the intervals causes rarefaction of the air in the cork particles, and the outer air rushes in; the contraction of the interstitial spaces causes condensation and escape of the air they contain. These two effects are still further increased by the heating and cooling of the air in the intervals alternately whereby the volumes are alternately increased and diminished. By these means alternate waves of compression and rarefaction are produced in the surrounding air, and it is to this that the sound which is emitted owes its existence.

At the World's Fair the source of light was an arc lamp. Its rays were rendered parallel by passing through the lens A and reflected from the transmitter B (which was placed in the gallery of Electricity Building) to the receiving instrument E at the front of the Bell Telephone pavilion, a distance of perhaps 150 feet. When some one spoke into the transmitter at *C* his words were audible to one at the receiving booth who placed the ear tubes F in his ears, but the articulation was muffled and indistinct.

This instrument was not thrown open to the public because of the difficulty of properly adjusting it, but a favored few, among whom was the writer, were fortunate in being given an opportunity of testing its capabilities. While the reproduction of articulate speech was not perfect, one was filled with awe when he realized that this speech, imperfect as it was, came to him through space literally on the wings of light; that it was conveyed to him by the same instrumentality which reached out from the farthest fixed star into the infinitudes of space, and it required but little effort of the imagination to conceive that the words thus heard did actually come from the depths of space and from an unknown inhabitant of an unknown world. All these theoretical possibilities crystallized for the time being into living actualities, and we mentally paraphrased the quotation of him who was in the depths of despair, "*De profundis clamavit.*"

The Effect of Initial Condensation in Steam Engines.

Mr. E. Tremlett Carter in his forthcoming book on "Motive Power and Gearing," now running as a serial in the *Electrician*, in speaking of the economies to be derived theoretically by the use of higher steam pressures, says:

"It may seem a pity that all the nice conclusions we have been able to draw from theory must be upset directly we turn our attention again to the disastrous phenomenon of initial condensation. Were it not for this wasteful effect, it would be possible to go on improving the economy of the steam engine, asymptotically approaching perfection, merely by the use of higher pressure steam, less clearance and an earlier cut off. As a matter of practice that is quite impossible; and with every steam engine it is found that there is a limit to the range of expansion beyond which the economy ceases to be improved, but rather is injured. The direct reason for this is that when the range of temperature of the steam in a single cylinder exceeds a certain number of degrees, depending on the speed of the engine, all known methods of coping with the initial condensation utterly fail, and the engine gives itself over to the wholesale production of water. Before that crisis is reached the limiting ratio of economical expansion for that particular cylinder has been arrived at."

NO INJUNCTION AGAINST BUCKEYE LAMPS.

Judge Lacombe has refused to grant the injunction recently applied for restraining Bloomingdale Bros. from using Buckeye lamps, holding, as did Judge Dallas in Philadelphia, that lamps lawfully made in one circuit could be lawfully sold in any other circuit.

Death of J. Hood Wright.

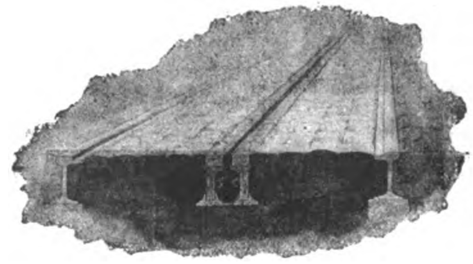
J. Hood Wright, a member of the firm of Drexel, Morgan & Co., died suddenly on Tuesday, November 13, in the Rector street station of the elevated railroad, from heart disease. Mr. Wright was well and favorably known to a large number of electrical men through his connection with the General Electric and Edison Illuminating companies of New York.

Conduit Electric Railways.[*]

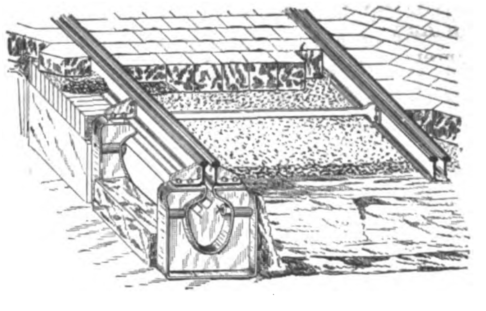
Is There a Solution of the Problem?

BY JOSEPH SACHS.

Mr. President and members of the New York Electrical Society: Scarcely a dozen years ago we did not even have a single inch, I may say, of electric railway in existence. To-day there are hundreds of miles in this country alone; but, strange to say, although its advance has been most phenomenal and the success of the so-called "deadly trolley" has been very great, there has existed a most extensive demand for a substitute for the trolley which should be free from the various objections which are inherent in the overhead wire. The main objection that exists is the overhead wire, and although we have advanced in the construction and operation of motors and gearing and power house machinery, we still remain at the same point that we did at the very beginning in the method of distributing the power to the motor on the car, namely, by means of an overhead bare wire. Now two substitutes have appeared to solve this problem: one has been the storage battery and the other has been the underground or conduit system. The storage battery car does not need to be explained; you are all familiar with it, and I need only say that although the storage battery has proved a failure in the past, and a severe loss to many of those who have invested money in enterprises of that kind, yet recent successes in that direction lead us to believe that it is more than a possibility, in fact a very great probability, that we may have a very successful storage battery system in the near future. But the point that I have under consideration to-night is not to solve the problem in that way, but to solve it by a center of distribution method, or a central station method, and I say the way to solve the problem in that way is by the conduit system.



THE BLACKPOOL SYSTEM.



THE BUDAPEST CONDUIT.

Hundreds of conduits have been tried—thousands of them I may say. And I may also say that perhaps no other branch of electrical engineering can boast of the vast variety of systems and plans that have been developed by various promoters as the class of conduit electric railways; in fact, of all the electric railway patents in the Patent Office to-day over one-half are conduit railway systems. It may seem strange, but perhaps the first thing every novice does who takes up electrical engineering is to devise a conduit electric railway. Probably that is the very reason why so many have not been successful.

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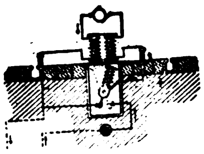
[*] Abstract of a lecture delivered before the New York Electrical Society, November 1.

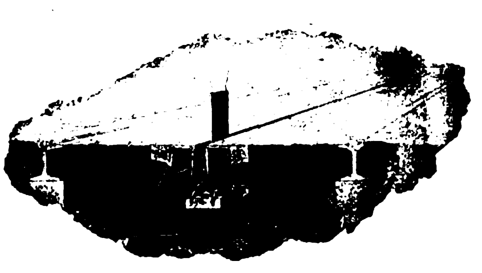
Why is it that success has not been obtained? One reason I have given you; the other is perhaps on account of some inherent difficulties, which I, however, doubt and which a great many others doubt; and another still is the very large cost of construction and maintenance, although the maintenance would seem to be less than the trolley.



SIEMENS SURFACE CONTACT SYSTEM.

From the fact that there are in operation to-day two electric conduit systems, it would appear that we could build other systems of similar character and somewhat similar construction and have them work successfully; but up to date nothing that has been successful, on a commercial basis, has been forthcoming. I think that in order to bring forth a successful system we must first study the problem most thoroughly and the real questions to be solved.

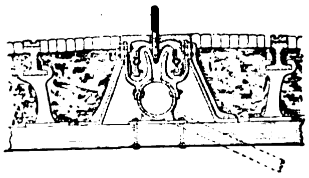
I have taken up the various systems that have been devised and divided them into six classes, and have selected some this evening of the more important, which I shall describe to you in their various classes and show you their points of advantage and disadvantage.



THE LOVE SYSTEM.

We shall first take up the various open slot continuous wire conduits.

The first system which I shall show you will be the well-known Bentley-Knight system, which was, as you all well know, one of the first attempts ever made in this country to solve the rapid transit problem by means of electricity. One illustration which I present shows the Bentley-Knight conduit as tried at Cleveland. It consisted of a very small open-slotted conduit with two wires suspended therein. The other view shows the plow. The conduit was exceedingly small and, although this road was operated for some time, it was at last abandoned. The road was opened in 1884, and, as I say, was the first attempt at electric traction on a commercial operative basis in this country.

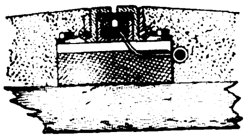


THE ZELL SYSTEM.

The Bentley-Knight people, however, were not satisfied with that attempt and got out another system. It had also a very small conduit, but instead of placing it in the middle of the track it was located at the side of the rail. Two wires were located therein and the plow coming down from the car came in contact with the wires, one on each side.

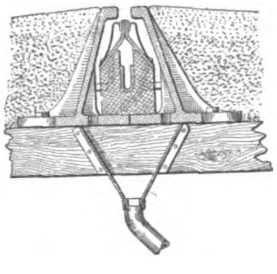
Another view shows a conduit installed as early as 1885, and although the apparent conditions would be exceedingly against its successful operation, strange to say it is operating to-day and paying dividends. I have reference to the Blackpool system, or Blackpool conduit, which is operated in Blackpool, England, to-day. The conduit is exceedingly small and the two wires are supported nearly directly below the slot, yet, as I say, the conduit is in daily operation.

The system which I now describe is the far-famed Siemens-Halske system, which is in operation to-day at Budapest. The conduit is a peculiar one. It is located directly beneath the rail. The car wheel is very dissimilar to that used in this country. It is a centrally flanged one, the flange running between the two rails, the object being to keep the slots open at all times. Two wires are used, one each side of the slot, although only one is shown here. Strange to say, this conduit has been in daily operation since 1889; dividends are paid by the road, and sixty cars are operating on six miles of double track. But I doubt very much whether a conduit of that size would operate on this side.

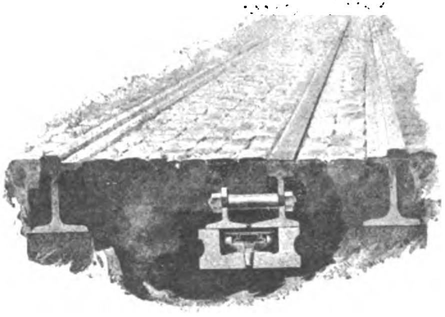


VAN DEPOELE'S CONDUIT SYSTEM, WITH FLEXIBLE LIPS.

Next we have, perhaps, the latest addition to open-slot conduits which is proving more or less successful. I have reference to what is called the "Love conduit." The yoke you see there is a construction adopted at Chicago where this system was first introduced. You see the promoters of this system had a better idea of the problem to be solved. We have here a large conduit and the wire placed high and dry, and furthermore about the most important thing of the system is that the wire is rendered accessible by placing above the wire a detachable slot rail or cover which can be raised at any time to permit inspection of the wire. It did not prove satisfactory for some reason or other, however, and when the same system was introduced in Washington another form of construction was adopted.



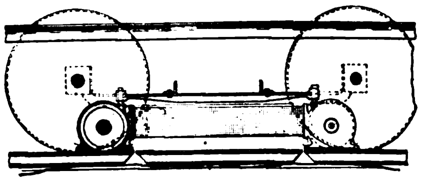
ANOTHER VAN DEPOELE FLEXIBLE LIP CONDUIT.



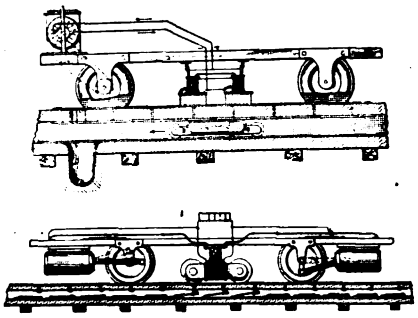
THE LINEFF SYSTEM.

One trouble no doubt was that a cheap conduit was wanted, which seemed to be the underlying principle of this whole matter, and for that reason the heavy yoke was replaced by a simple trough located between the tracks. This conduit, I understand, is to-day in operation in Washington, and whether fully successful or not I do not know.

Now we come to some of the possibilities and suggestions. One is the Griffin conduit, the only feature of which consists in the fact that the conduit is divided into two compartments, in one of which the wire is located, the other being used for drainage. The advantage of this form of construction is apparent and is also borne out in the form of construction which is called the Zell conduit, in which we have a drainage tube in the center beneath the slot, the wire being supported in two separate compartments, one on each side of the drainage tube. Both of these systems, as I say, are suggestions.

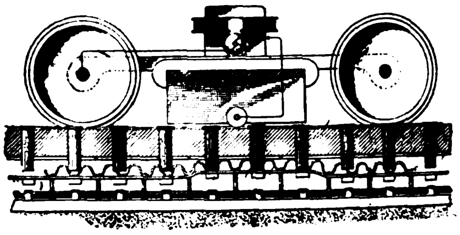


LINEFF SYSTEM.



VAN DEPOELE MAGNETIC SURFACE CONTACT SYSTEMS.

Now you will please take notice that most of those various forms of open-slot conduit which I have shown you possess several points of disadvantage. First, they have the disadvantage that in nearly all the forms which have been tried the conduit has been extremely small; the wires have been unprotected and poorly located; they have been placed low instead of high; the insulators have been poor and inaccessible; and the problem seems to have been attacked from the wrong standpoint, namely, to get a cheap system to compete with the trolley.



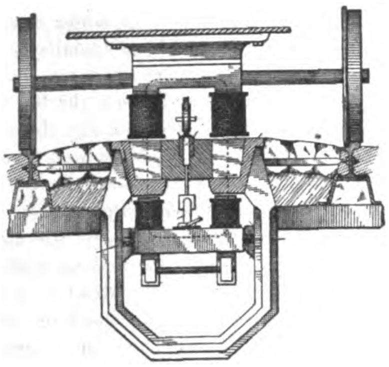
LT. F. JARVIS PATTEN'S SURFACE CONTACT SYSTEM.

We will leave the open-slot conduit for a while and take up what we call the movable lip or cover conduit. In this form of construction the aim has been to protect the wire by covering up the slot except when the trolley is passing. One of the best known of this kind of systems is the Van Depoele conduit, the invention of the late well-known electrician, Mr. Van Depoele. He devised a form of construction which is shown in the two accompanying illustrations, both of which have flexible lips which cover the slot of the conduit containing the wire. The conduit in one, as you see, is very small, and there are two lips which press together over the slot which are pushed aside by the plow of the car as it comes along but close again after the car has passed.

In another form which Mr. Van Depoele has devised he puts the same construction inside of mewhat larger conduit.

In still another form the wire is located in a trough within the slotted conduit and covered by two shutters which are pushed aside by the plow. These shutters are made in short sections and close up again after the plow has passed.

Now we come to another system which has recently been exploited in this country, called the Patterson system. The conduit is very small and divided into two compartments. The wires are located in one compartment and there is a cover which is pushed aside by the plow. The construction needs no explanation, as you see by the small drawing in the upper corner how it operates. This system has not been tried.



PATTEN'S PERFECTED SIEMENS SYSTEM.

The difficulty with these open-slot flexible cover or movable cover conduits is practically the same as with the previous class with the additional disadvantage that we have not yet found a flexible material that will stand the strain of every-day railway traffic, and the shutters when made of metal cause a great deal of noise and do not seem to afford much protection against injury to the wire.

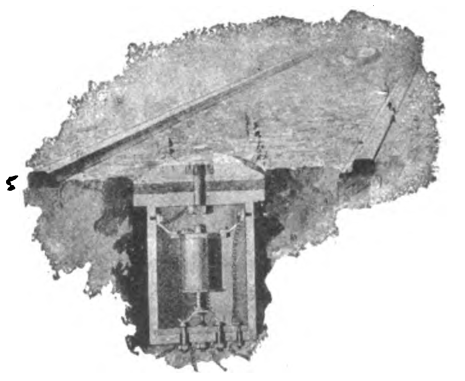
The next class we come to is known as the surface contact system. It holds forth certain alluring attractions in the way of cheap first cost and dispenses with the open slot, and has therefore received a great deal of attention. The system is typified by the well-known Lineff system and has been tried experimentally. It consists of a sectional iron contact rail which is flush with the street surface. It is made in sections of six to ten feet, placed on top of the conduit, which is entirely closed, and is composed of some insulating material in which is laid a strip of copper attached to the bottom of which is a strip of iron, and this composite strip is connected with the source of supply. Upon the car, placed longitudinally with the track, is a magnet having a wheel at each end. When the magnet is energized the composite strip is attracted up against the rail and naturally connects that section of the rail with the dynamo; and so as the car moves along the magnet pulls up the strip and connects each successive section of the contact rail with the source of supply, and thus supplies the motor on the car. I will not dwell any longer on this system as I have a number of others to show you.

We have another surface contact system, devised by Mr. Van Depoele, which is practically the same in principle. The contact conductor consists of a number of sections on the surface of the street; the contact device or collecting plow consists of a magnet, the poles of which are brushes. The switching device is a small car which runs upon rails in the conduit and directly beneath the sectional contacts. The lower rails form the supply conductor and the car acts as a connection between it and the section above. As the motor car runs along, the magnet beneath pulls the little car in the conduit after it and thereby connects each successive section with the supply wire.

Then we have another system of Mr. Van Depoele's, in which are a number of levers inside of the conduit beneath the sectional conductor. and as a magnet moves along the switch levers are pulled up against the respective sections, and in that way the contact is made all along the line in each section of surface contact conductor. After the car has passed and the magnet passed the section the lever beneath will drop back and disconnect.

We have a system of Lieut. Patten's, which is very much the same as the Lineff system. It consist of a band of iron, as you see, and upon the car is mounted a magnet, the difference being that this magnet is placed transversely instead of longitudinally to the track. The band is pulled up against the rail by the magnet which forms the magnetic switching device, and also against a central contact which forms the sectional conductor.

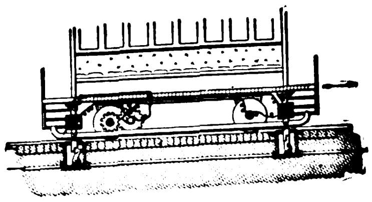
And we have a system devised by Messrs. McElroy, Nicholson & McTighe. One of these as shown is very similar to one of the forms of the Van Depoele system. Instead of using a sectional rail contact, plates are used which are located between the track on boxes in which the switch mechanism is placed. The poles of the magnet are very long and project from the plate on one box to the next. In the box a small lever is pivoted and connected to the supply wire. When the magnet on the car is over the box the lever is attracted up against the contact plate and connects the same with the supply wire and the current is taken off by the long bar which forms the pole of the magnet. As will be understood, the long bar is long enough to span two contact plates.



THE M'ELROY, NICHOLSON & M'TIGHE SYSTEM.

There is another system, in which the boxes are located in the center of the track; devised by the same inventors. Instead of having a lever an electro-magnet is used and the current is sent down through each successive contact head and through the magnet and the connection made between the contact plate and supply wire just as in the magnetic switch by the magnetic plow. Instead of using a magnet at the bottom of the car a brush or contact bar is used. The current is sent down through the head into the magnet, which then pulls up the switching device at the bottom, instead of it being directly operated by the magnet on the car.

We also have a system which I have had a little experience with and which has made me a little doubtful respecting the ultimate success of the surface contact system. It is a system in which very much the same methods were adopted as in the McElroy, Nicholson & McTighe system. As in the last system described, contact plates are used, but the electro-magnets are not placed under the plates but in accessible manholes or placed upon posts along the road. A number of them controlling a section are grouped together. This shows the system. The brush, which is located under the car, is always in contact with two or more heads. The conduit really consists merely of a small trough in which the wires are run to the various switching magnets which are all located together. The system was originally the invention of Mr. G. T. Woods.



THE M'ELROY, NICHOLSON AND M'TIGHE SYSTEM.

(*To be continued.*)

New Electrolytic Method of Producing Aluminium.

The *Engineering and Mining Journal* for September 8 describes a method proposed by the Aluminium Company of Neuhausen, Switzerland. The material operated upon is aluminium sulphide, which can readily be dissociated by passing an electric current through it when melted, the fusion being effected either by the current itself or an external source of heat. As compared with other methods a comparatively low electromotive force is required to accomplish the reduction, and the carbon electrodes immersed in the bath of molten sulphide are not affected, as the reduction takes place at a temperature below that required for the combination of carbon with sulphur. As, however, pure aluminium sulphide is difficult to produce, and consequently expensive, it may be replaced by a double sulphide of aluminium and some alkali metal, that with sodium obtained by heating alumina with carbon, sulphur and sodium sulphide being the most convenient one, as it is readily soluble in a bath of molten alkaline chlorides and fluorides.

What Is Electricity ?

An anonymous writer in the *New Science Review* offers the following definition for criticism: "It would appear that electricity is simply a form or manifestation that the one force better spoken of as energy may assume under given conditions, and generally it is a mere transitory stage between the mechanical form and the heat form. In most operations mechanical force passes to the heat form without passing through the electric form, but whenever magnetism is brought into play as a resistance that must be overcome, then mechanical power applied to overcome this resistance always becomes electricity, if only momentarily, in its passage from the mechanical to the heat form.

"Can we not answer in a fairly satisfactory way the question, 'What is electricity?' by saying that it is simply a form that energy may assume while undergoing transformation from the mechanical or the chemical form to the heat form, or the reverse?"

Interior Illumination.

Electrotechnische Zeitschrift for August 30 has an article on interior illumination with arc lamps. For small arcs a method is described in which a small translucent glass screen, in the form of the frustrum of a cone, encircles the carbon points where the arc is formed, appearing like a large incandescent mass. This is applicable only to small arc lamps. For large interiors he suggests throwing the light on the ceiling by using an inverted arc; this causes, however, an unsteady burning of the arc because the crater of the lower carbon acts as a receptacle for the ashes, which cause an unsteadiness in the burning of the lamp until they have been volatilized.

A Tax on Bad Service—A Good Idea.

In granting the right for the construction of an electric railway in a town near Berlin the municipality requires that a fine of $500 be paid to the city if there is any interruption in the running of the cars for which there is not sufficiently good reason.

The Chemical Theory of Accumulators*—V.

BY E. J. WADE.

The thermo-chemistry of the discharge phenomena having been considered, it remains to examine it in its more purely chemical aspect. To begin with, the occluded gas theory may be put aside as having no evidence at all to support it, while, as has been already mentioned, the results of the experiments of Gladstone and Tribe, Frankland and others are directly against it. This practically limits the discharge reactions to the formation of one or both of two classes of compounds, namely, oxides (lower than PbO^2) and sulphates.

Now, it is a perfectly well-established property of the oxides of lead that none of them, with the exception of the peroxide (PbO^2), can exist unacted upon in solutions containing more than a very small percentage of free sulphuric acid. Litharge or massicot (monoxide PbO) is directly converted into lead sulphate with the liberation of water.

$$PbO + H^2SO^4 = PbSO^4 + H^2O.$$

The sesquioxide (Pb^2O^3) and minimum or red lead (Pb^3O^4) behave as if they were mixtures of monoxide and peroxide; that is to say, they break up into mixtures of sulphate and peroxide.

$$Pb^2O^3 + H^2SO^4 = PbO^2 + PbSO^4 + H^2O.$$
$$Pb^3O^4 + 2H^2SO^4 = PbO^2 + 2PbSO^4 + 2H^2O.$$

It is true that these reactions do not take place with great rapidity, and that a considerable time may elapse before the final portions of oxide are completely acted upon; but this is due to the protective powers of the insoluble sulphate, which, as fast as it is formed, clogs up the pores and impedes further access of acid to the interior of the mass; and this effect will naturally become more marked as the proportion of sulphate present increases.

In view of the above facts it seems unreasonable to suppose that these oxides are formed or exist in lead cells in the presence of free sulphuric acid, as to do so implies that their chemical properties or affinities are then entirely modified in some way or another.

Undoubtedly very incomplete sulphating, accompanied by the formation of large quantities of monoxide, did occur in many of the earlier forms of pasted cells, and occasionally in more recent ones, but a close examination would reveal the fact that in all such cases the supply of acid in the pores of the active material was insufficient, owing, either to the solution being too weak or to imperfect diffusion from the active material itself being too dense and used in too large unbroken masses, such as are obtained when a considerable quantity of it is packed round a central conducting core or into a hollow receptacle. (This does not necessarily imply that comparatively large blocks of active material may never be used, for if they are sufficiently porous they may be far more efficient than a more subdivided material which does not possess this property in so high a degree.) The inevitable result of discharge under these circumstances is, that almost the whole of the acid is very soon withdrawn from the electrolyte immediately surrounding the inner surfaces of the electrodes, and then a formation of a mixture of monoxide and sulphate does certainly take place; but this cannot be considered to in any way represent the normal working conditions.

While, however, the assumption of the formation of oxides is opposed to all chemical knowledge, it appears at first sight that, as far as the positive electrode is concerned, it is equally opposed to the laws of electrolysis to assume a direct formation of sulphate, and in order to reconcile these two conflicting points of view the theory was propounded that although sulphate is the ultimate product, the reaction takes place in two stages; first a reduction of the peroxide to monoxide, which is a normal electrolytic action, and then an immediate conversion of the monoxide into sulphate by a heat-producing "secondary" or "local" action, and then an immediate conversion of the monoxide into sulphate by a heat-producing "secondary" or "local" action. With the exception of Mr. Swinburne, who has been an uncompromising advocate for the direct sulphating of the positive from the very first, this view has been the one most generally held since the publication of Messrs. Gladstone and Tribe's researches in 1883, and probably remains so at the present time.

The electrolytical difficulty lies chiefly in comprehending how it is possible to obtain any E. M. F. from a cell in which the same compound is formed at both poles, much less for it to be proportional to the *sum* of the two effects; and the case is considered as if it were similar to that of two plates of zinc both dissolving in sulphuric acid to form zinc sulphate and neutralizing each other's E. M. F. The objection is, however, only a superficial one, based on loose and erroneous views of what is essential for a galvanic action and the generation of an E. M. F., and gives way when carefully looked into.

Consider the following electrolytic equations:

$$\begin{array}{llllllllllll}
Zn & SO^4H^2 & SO^4Cu & C & & = ZnSO^4 & H^2SO^4 & Cu & & C & (1)\\
Zn & SO^4H^2 & SO^4Cu & SO^4 & C & = ZnSO^4 & H^2SO^4 & CuSO^4 & & C & (2)\\
Zn & SO^4H^2 & SO^4Zn & SO^4 & C & = ZnSO^4 & H^2SO^4 & ZnSO^4 & & C & (3)\\
Pb & SO^4H^2 & O & Pb & SO^4 & C = PbSO^4 & H^2 & O & PbSO & C & \\
 & & & O & H^4 & & & & O\ \ H^2 & & (4)
\end{array}$$

The first is that for the reactions taking place in a Daniel cell, in which the zinc is immersed in dilute sulphuric acid and a carbon electrode used to receive the deposited copper; modifications of the most usual practice which can be, and, indeed, actually are sometimes made, without in any way interfering with the principles of the cell's action. As is well known, its E. M. F. and the resultant energy liberated are due to the difference between that generated in the formation of zinc sulphate at one pole and that absorbed in the decomposition of an equivalent amount of copper sulphate at the other pole.

Equation (2) represents the same combination with the addition that free sulphion (SO^4) is supposed to be present at the carbon electrode to combine with the copper which would otherwise be deposited. What may be termed a double depolarization now goes on, the copper sulphate acting as a depolarizer with respect to the hydrogen of the hydrogen sulphate (sulphuric acid) and the sulphion as a depolarizer with respect to the copper of the copper sulphate; and the ultimate result is the *formation* of a compound at both poles—zinc sulphate at the one, and copper sulphate at the other—while the whole energy and E. M. F. due to the formation of zinc sulphate is now realized.

In equation (3) the copper sulphate is replaced by zinc sulphate solution. This does not affect the E.M.F. of the cell, which is still simply that of the formation of zinc sulphate or about three volts, and yet identically the same compound is now being simultaneously produced at both poles. Of course, such a cell is not practical, because sulphion cannot be obtained in a free state, and certainly could not exist as such in an aqueous solution; but if it is replaced by chlorine and, at the same time, zinc chloride substituted for zinc sulphate, and hydrogen chloride for hydrogen sulphate, a perfectly possible combination is obtained whose action may be represented by the following equation:

$$Zn \quad Cl^2H^2 \quad Cl^2Zn \quad Cl^2 \quad C = ZnCl^2 \quad H^2Cl^2 \quad ZnCl^2 \quad C, \qquad (5)$$

and one which also forms the same compound—now zinc chloride—at each electrode. The combination may be yet further simplified by doing away with the acid altogether, and placing the zinc direct in the zinc chloride solution without practically affecting its E. M. F. or the compound produced—still zinc chloride at both poles—

$$Zn\ Cl^2Zn \mid Cl^2 \mid C = Zn\ Cl^2 \mid Zn\ Cl^2 \mid C\,; \qquad (6)$$

but it now corresponds to one—the "Upward" cell—which has been used with some considerable success for small lighting installations and other purposes, and gives an E. M. F. of about two volts per cell in spite of this double formation of zinc chloride. Theoretically, the E. M. F. of such a combination lies between 2·1 and 2·4 volts, according to the strength of the solution.

To return to equation (4) which represents the discharge of a lead storage cell on the assumption that lead sulphate is formed at both electrodes; a backing of carbon instead of lead for the lead peroxide being supposed in order to facilitate comparison with the other equations. The peroxide acts as a depolarizer towards the hydrogen of the acid, half of its oxygen being abstracted, and a further portion of acid acts as a depolarizer towards the monoxide so formed, with the production of lead sulphate and water; but there are no grounds for discriminating between the two actions and saying the one is electrolytic and the other not, any more than there would be for treating the combination of zinc and copper with sulphion in equations (2) and (3) or with chlorine in equations (5) and (6)—the similarity of whose reactions will at once be observed as mere heat-producing secondary actions.

The fact is, the whole tendency of modern theories of galvanic and electrolytic action is to show that the old time distinctions between "primary" and "secondary" actions is purely artificial and cannot be maintained. Only a few months back, Ostwald emphasized this point in a Paper, reproduced in *The Electrician* for June 29th of the present year, on "Modern Electro-Chemical Theory and its Bearing upon the Practice of the Future," and showed that the whole of the reactions, as indicated by the ultimate products at either pole, must be considered equally electrolytic. The specific example selected to illustrate the subject was singularly apt, being the stock text book one of the electrolysis of a solution of potassium sulphate, which was always said to be first split up into potassium and sulphion by a primary electrolytic action and then these substances combined with water to form potassic hydrate with the liberation of hydrogen, and hydrogen sulphate with the liberation of oxygen, by a secondary chemical action. Now, however, the only action that can in any way be considered as secondary is the gradual combination that will take place, *not at the electrodes* but in the body of the solution, between the free potassic hydrate and free sulphuric acid to re-form potassium sulphate.

(*To be continued.*)

Commercial Efficiency of Accumulators.

L'Industrie Electrique for August 10 gives the results of carefully kept records of the input and output of accumulators in constant use at the Clichy sector in Paris. The battery consists of two sets of 250 cells each; the total weight of plates in a cell is 330 lbs., the normal output 250 amperes, and the corresponding capacity 2,000 ampere-hours; the necessary increase in voltage for charging being obtained by means of a separate dynamo. A table is given containing the monthly charges and discharges in watt-hours and the efficiency for each month, the mean of which is 69 per cent.

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* From *The Electrician*, London.

Electrical Heating.

The advantages of electricity for heating are being recognized. A manufacturer in the south of France proposes to employ water power for heating his factory, thus saving 30,000 francs per annum in fuel. In South America an electric drying machine, in which air is forced through a chamber of heated plates and comes out as a hot blast, is to serve in drying wheat, the current to be generated by waste water power. Other plans proposed are electric heat for use with ammunition caps, and for electric soldering irons to be employed in a gunpowder factory where the irons must not get hotter than 450° Fahr. Probably the most curious application now being arranged is one to prevent the freezing of a clock. A large town clock in an exposed place often gets clogged with snow and ice in winter, and this is to be remedied by placing an electric hot plate on the top or side of the clock.

Magnetic Treatment of Zinc Ores.

Electro-magnetism has found a new application in the arts. All are familiar with the attempts that have been made to concentrate iron ores by this means. This practice is, however, only applicable to the ores which are magnetic, viz., those which consist either wholly or in part of the magnetic oxide (Fe_3O_4) of iron and known as magnetite. Among the zinc ores there is but one—franklinite—that is magnetic, so that in the raw state the other ores, which on account of their much wider distribution are of far greater importance, cannot be thus concentrated. Zinc blende, for instance, which is the most widely distributed of all zinc minerals, is entirely non-magnetic, but it usually contains considerable iron as an impurity. This ore requires as a preliminary treatment a careful roasting to remove the sulphur, and it is now proposed to so conduct this roasting process as to convert the iron in the ore into the magnetic oxide and thereby make it amenable to magnetic concentration. In fact, we believe this process has already been carried out successfully on a small scale.

The chief interest which attaches to it lies in the fact that if zinc blende can thus be rendered concentrable the process will certainly be applicable to a wide range of other ores, not only of zinc but of silver, gold, tin, etc., for there are few ores of any of the metals that do not contain considerable proportions of iron either in their chemical make-up or as impurity.

The Heating Power of a Glow Lamp.

While an ordinary incandescent is the least likely of all illuminants to ignite inflammable materials, there are special conditions under which its heat will start combustion in highly combustible substances. The *Gas World* observes that Mascart found that a glow lamp of 32 candles set fire to cotton wool saturated with indiarubber, and packed round it, in two minutes; to black silk in six minutes; and to a double layer of cotton cloth in two minutes. The same materials not saturated with indiarubber did not take fire. Capt. Exler, of the Austrian army, now finds that a 16-candle lamp, sunk in paraffin, reaches a maximum temperature of 94° C.; one of 25 candles, 101° C. A layer of gunpowder, ecrasite, or pulverulent pyroxiline is not set on fire by this: the ecrasite melted and the gunpowder lost all its sulphur. If the substance be spread on a material, e. g., wood, which is opaque to heat rays, the action is more marked when the lamp is brought very near to it: the ecrasite melts, the pyroxiline darkens, the gunpowder loses its sulphur and the niter melts and the wood chars. Two lamps in a cavity of wood got up a temperature of 215° C., a charring temperature; but the explosives did not go off, though they decomposed. When the cavity was filled with water it boiled in fifteen minutes. The spark produced on turning off the flame only kindles these explosives when they become very dry; but the spark produced on switching off a feeble resistance between two lamp wires can do so readily. If the lamp breaks, pyroxiline or gunpowder does not ignite, but an explosive gaseous mixture will do so.

Cheaper Lights in Syracuse.

The Citizens' Electric Company of Syracuse, which Paul T. Brady recently organized for the Westinghouse Company, is making tempting propositions to the city, and it seems likely there will be no difficulty in obtaining the franchises and privileges asked for.

They offer street lights to the city at 25 cents a night, as against the present rate of 30 cents, and to do commercial lighting on the basis of 10 cents per 1,000 watts.

This would be a saving to the city and individual users of about $125,000 for the term of the next city contract on the same amount of lighting as is now done by the old company.

Electricity on Shipboard.

Members of the A. I. E. E. are cordially invited to attend the second general meeting of the Society of Naval Architects and Marine Engineers, to be held at 12 West 31st street November 15 and 16. Among the papers to be read of especial interest to electrical engineers is one by Lieut. Samuel Dana Greene, on "Electricity on Shipboard: its Present Position and Future Development.

LEGAL NOTES.

At Tacoma, Wash., the Edison General Electric Company has petitioned the Superior Court for leave to demand of and if not successful to sue the receiver of the Point Defiance Railway Company for electrical property owned by the petitioners. Leave was granted. The property consists of fourteen motors, eight McGuire trucks, wiring and other supplies of a total valuation of $11,267.73.

The Jacksonville Electric Light Company has applied to the Circuit Court at Jacksonville, Fla., for a temporary injunction restraining the Board of Works from putting in an electric light plant contracted for with the General Electric Company at a cost of $72,000. The plaintiffs are the owners of an electric light plant in Jacksonville valued at $30,000, and claim to be able to furnish all the electric lighting necessary to supply the wants of the inhabitants. They hold that the city has no right to furnish private individuals with lights, and that the cost of the plant ordered exceeds the cost of a plant adequate to light the streets and other public places and buildings by $35,000 or $40,000, and was made with the intention of deriving revenue and income from private lighting. In other respects it is claimed that the contract is in violation of certain sections of the Laws of Florida.

Suit will soon be brought at St. Louis to test the validity of the omnibus charter of the Laclede Gas Light Company. It will be brought in the shape of an injunction to restrain the city from interfering with that company in putting in a subway conduit for the purpose of burying its wires. The suit will likewise settle the question as to whether the Laclede Gas Light Company has the right to construct a conduit to lease to other electric light and power companies. "The charter granting the franchise to the Laclede Gas Light Company," says the St. Louis *Post-Dispatch*, "was drawn up by Attorney Charles Gibson. Although in 1857 such a thing as electric light was unknown, Mr. Gibson some way or other, he doesn't exactly know how himself, got the idea that sooner or later electricity or something else would take the place of gas, and so the words, 'Any other substance which may be used as a substitute,' were inserted. The wisdom of the thought is now shown. The legal contest will be hotly contested and will be watched with a great deal of interest, as the future of the conduit question depends largely upon its result."

RAPID TRANSIT FOR NEW YORK.

The feature of the recent election in New York City that most interests electricians as such is the favorable vote of the people which decides the question in the affirmative as to whether or not the city's financial credit should be pledged to the construction of the tunnel for rapid transit.

The completed returns from the election show that the people have decided by a majority of about 69,000 votes in favor of the construction by the city of a real rapid transit road.

Under the law the work of construction of the road must be begun within thirty days after the result of the election is officially made known to the Rapid-Transit Commission. The road will be an underground one—of that there is no doubt—and it will be operated by electricity as it has been found impossible to secure proper ventilation where steam is used.

The route, according to the plans of the old Rapid-Transit Commission, which have not yet been changed, is, broadly speaking, from the Battery through Broadway to the Boulevard, along the Boulevard to the northerly limits of the city. A branch also extends from Union Square up Fourth avenue to Forty-third street. An East Side route is also provided for. The Commissioners are empowered to change or modify these plans in any way that they see fit.

The cost of construction, which will be paid by the city, will be met by an issue of bonds, probably at 3 per cent., to such an amount as may be necessary up to $50,000,000. The parties building and operating the road must pay for that privilege an annual rental sufficient to defray the interest on this bond issue, with 1 per cent additional, which will form a sinking fund for the redemption of the bonds when they mature. The successful contractor will be required to give a bond of $1,000,000 for the faithful performance of the undertaking, and must equip the road with engines, cars, etc., at his own expense, on all which property the city has a first lien. The Board of Commissioners are empowered by law to fix the rate of fare.

A resolution has been adopted which provides "that public hearings be given by the Commissioners Tuesday and Wednesday, November 13 and 14, from 1.30 to 4.30 P. M., at which persons will be heard who desire to suggest changes in the routes already provisionally adopted by this board, and to make suggestions as to the extension of the East Side route above the Grand Central Station."

President Orr says: "We cannot put off the work, as the law is mandatory upon us. It is the unanimous desire of the Commissioners to push right ahead. A general plan has already been formulated and probably will be the one finally adopted, although there may be changes in it. The Commission is not restricted as to making changes in the plans, or adopting entirely new plans for that matter. The legal objections that have seemed to exist, our counsel advise us, can in all probability quickly be done away with."

Regarding the thirty-day clause, Secretary Delafield had this to say: "That clause must be read in connection with that part of the act which gives the Commission the right to change or modify the plans or even to adopt new plans. The two, read together, make it evident that the intent is that the contract shall be given, not thirty days after election, but thirty days after the Commissioners finally agree on plans. The perfecting of the East Side line plans will undoubtedly take several months."

The Government Will Have Its Own Telephone System.

It will soon be settled whether or not a reliable telephone service can be owned and operated outside of the Bell privilege at Washington. Bids were received and opened a month ago for a complete independent telephone outfit for the Interior Department, but were all rejected on account of technicalities. Advertisement is about to be made again under the new proposals, and work will be pushed to complete a system connecting the Interior Department and all its bureaus before next spring. If this is successful it is probable that the Government will adopt the telephone largely as a valuable aid to business in all its branches.

The Turnbull Lamp.

In spite of the fact that prices of incandescent lamps have been reduced to a point leaving little profit, a great many people are getting ready to enter the business for the first time after this month. ELECTRICITY wishes them all luck, and is sure they will learn a great deal more about the lamp business than they know now.

It is a safe assertion, however, that no lamp maker can weather the storm of the next twelve months unless he can make, with a small percentage of bad or uneven voltage lamps, at least 8,000 lamps a day and *sell them*.

The latest public announcement is that of the Turnbull Electric Lamp Mfg. Company, Limited, whose backers hope to raise money and start a factory at Cincinnati.

It is a stopper lamp, the glass tube around which the filament is coiled being lined with silver, "forming a reflector."

From the claim that the "lamp can be maintained with 20 per cent. less dynamic energy than present types," we suppose they expect to make a two-watt lamp.

Death of Francis Callanan.

Francis Callanan, treasurer of the Union Traction Company, was killed by falling under the wheels in attempting to jump on a moving train on the Erie Railroad at Rutherford, N. J., on the 5th inst.

Mr. Callanan was forty-two years old and very wealthy. He was born in Utica, N. Y. He began his railway life in the office of the Midland line in Utica, and afterwards became secretary and treasurer of the Utica City Railway. He built the People's line of Syracuse, and bought the Oswego Street Railway line. Afterward he moved to Rutherford and managed his interests from his office on Wall street, New York. He organized the People's Railway Company, of Brooklyn, and was made its president. He also organized the Union Traction Company of New Jersey, incorporated but a few days before his death, which was to build an electric line from Newark through Rutherford to Hackensack.

To Found a School of Science.

Mr. Westinghouse Said to be Preparing to Endow a New College for Pittsburg.

(From the Pittsburg Despatch.)

The Westinghouse Electrical College and School of Science is a probability of the near future for Pittsburg. Mr. Westinghouse has given voice to his desire in this line and his plan of the establishment of such a college in this city receives the cordial indorsement of the leading electricians and mechanical engineers.

Details are as yet meager. The reticence of those interested and the absence of Mr. Westinghouse from the city preclude particulars. Matters have so far progressed, however, that several meetings have been held. Wilkinsburg is mentioned as the probable site for the college, and the question under discussion at present is whether or not the school should not be opened immediately in a temporary building pending the erection of a permanent structure which shall in construction and equipment be the equal if not the superior of any electrical school in the country.

COMMUNICATION.

Storage Batteries and Customs Laws.

To the Editor of ELECTRICITY.

DEAR SIR: I have just been advised through ELECTRICITY that the Board of Appraisers has decided that storage batteries purchased abroad for educational purposes are dutiable. I desire to give a few additional facts regarding the case at issue between the Armour Institute and the Board of Appraisers. At the close of the World's Fair an opportunity was offered the Institute to secure a few cells of Pollak battery for purposes of test and comparison with its 125 cells of American make.

The University of Michigan had already secured some 33 cells of the same make, and entered the same free of duty, but when, later on, the application of the Armour Institute came before the Board, it was rejected on the ground that the storage batteries were not *philosophical apparatus*. We have heard much lately about discriminating lightning arresters, but the Board of Appraisers have put themselves on record as most efficient discriminating *battery* arresters. It is difficult to understand why commercial types of dynamos, ammeters, etc., are permitted to be imported duty free by colleges, under the head of philosophical apparatus, and storage batteries excluded as not belonging to this classification. It may be that this is but another note in the death-knell of the storage battery as possessing any scientific value.

The news that the National School of Electricity has established an active branch in New York is most refreshing, and let it be hoped that one of its first missions will be to dispel the clouds of dense ignorance of matters electrical and scientific to which such decisions as the above cannot but be ascribed.

W. M. STINE.

Armour Institute, Chicago, Nov. 5, 1894.

[We had no desire to misrepresent the position of Armour Institute, and agree fully with Prof. Stine's views as to the injustice of compelling the payment of duty on distinctively scientific apparatus for educational purposes. We do not see, however, how the National School of Electricity can accomplish any real good until its chief promoters have stepped down and out and the school discontinues its fraudulent misrepresentations. It can claim no title to respect or confidence until it ceases to pose as a philanthropic enterprise and ceases to use the names of men who have disowned any connection with it. Standing solely for what it actually is, it might be of some good to the world.—ED.]

Cast Steel and Cast Iron for Dynamos.

The *Electrotechnisches Echo* for August 11 has an article discussing two dynamos, differing only in the field magnet frame and field winding, in one of which cast iron is used and the other cast steel. From curves he shows that with cast steel 12,000 lines of force per square centimeter (12 kilogausses) can be used, and for cast iron 6,000, the former requiring 6.4 ampere-turns and the latter 28 ampere turns per centimeter length of magnetic circuit. His calculations show that 5,800 ampere windings would be required for the cast iron, as against 3,330 for the cast steel magnets. His conclusions are that the weight of the magnet frame will be reduced to one-half, and the weight of the copper for the magnets to somewhat less than one-half in the cast steel magnets; the price of the steel is about twice as great, but on account of the reduction in the amount of copper the machines will be cheaper. He adds that there is a disadvantage in that cast steel is of such widely differing qualities, and can therefore not always be relied upon without special testing.

Personal.

Among the Boston men in New York last week were Frank B. Parsons of the Davidson Ventilating Fan Company, and C. J. H. Woodbury.

Mr. Gilbert M. Harvey, formerly with the Narragansett Lighting Company at Providence, has accepted the position of superintendent of the lighting station at Portland, Me.

Mr. James G. Godfrey, of the New York Insulated Wire Company, has returned from an extended Southern and Western trip.

Mr. Harry Allen, who was until recently assistant to Mr. Aylsworth in the carbonizing department of the General Electric Company's lamp works, has left that company and is now associated with the new firm of Aylsworth & Jackson, manufacturers of incandescent lamp filaments, Orange, N. J.

Mr. Frederick Nicholls of the Canadian G. E. Co., Toronto, is a New York visitor this week.

Canadian Notes.

Toronto is being treated with an investigation into certain charges of "boodling" amongst a number of the principal aldermen which is creating considerable sensation. The chairman of the Fire and Light Committee, Alderman A. D. Stewart, has been directly charged by the manager of the Toronto Electric Light Company with seeking to abstract some $15,000 from his company in connection with a recent proposition on the part of the city to go into the business of supplying light themselves. Mr. Wright in the witness stand stated that in conversation with Alderman Stewart in that gentleman's office some months ago he was told that if the idea of a municipal plant was to be knocked out his company would have to pay for it, and furthermore designated the above sum as the amount which would be required to "square" himself and friends in the council. After the proposition of a civic plant had been voted down, tenders for city lighting were called for, and in connection with these there are also a number of charges against Alderman Stewart and his colleagues of a damaging character. A great deal of correspondence has been produced between aldermen and outsiders in connection with the matter which lends a very suspicious color to the conduct of some half dozen or more of the principal aldermen. The result of the investigation promises to be most interesting.

Rumor has lately been busy with the affairs of the Royal Electric Light Company of Montreal. It has been stated that Senator Thibaudeau was about to retire and that his place was to be filled by Sir Joseph Hickson, but this has been emphatically denied so far as Sir Joseph is concerned. A meeting of the shareholders has been called for the 15th inst. to approve of an issue of $750,000 of debentures.

Messrs. J. W. Gage, Drs. Bingham and Griffin, and Myles Hunting, of Hamilton, recently made a trip to Detroit to investigate the Harris system of operating street cars, which does away with poles and all overhead construction, and have expressed the greatest satisfaction at the possibilities of the system.

Mr. T. Viau, projector of the new electric railway between Hull, Aylmer, Gatineau Point, Chelsea, Ironsides and the Peche, waited upon the municipal council of Hull a few days ago for the purpose of seeking a charter to operate his system of cars along the Gatineau road. The council now have the matter under consideration, but it is thought no objection will be raised in connection with it.

A Card of Thanks.

The publisher of ELECTRICITY acknowledges the receipt of a necktie presented by Messrs. Robert Bigman Corey, Stephen Artistic Douglas and Reuben Busy Ayres.

Boston Notes.

The wind, rain and snow storm which raged throughout New England Monday night of last week proved to be the most disastrous one that has been experienced for several years. Especially was this the case with the electric light, telephone and telegraph companies. Their overhead wires and the poles they were suspended from suffered fearfully; especially in Massachusetts was great damage wrought.

The telephone and telegraph wires are to be placed underground in the city of Chelsea, an ordinance to that effect having at last passed the city council. The matter had been debated for over three years.

On August 16, 1893, a sanguinary riot took place at North Abington, Mass., between a gang of Old Colony Railroad employes and a gang of men in the employ of the local electric railway company. Suits were entered against the Old Colony Railroad officials for inciting the rioters and the cases were tried before Judge Sherman last week. After hearing the evidence the Judge imposed a sentence of four months' imprisonment on John C. Sanborn, division superintendent of the Old Colony Railroad; C. T. Bailey, detective, four months; A. L. Frazier, foreman, two months; John Bolen, section foreman, two months, and Emery B. Bryant, roadmaster, two months. These officials were at once marched off to jail to work out their sentences.

The contemplated strike which was to have tied up the entire West End Railroad system of Boston did not materialize. Mutual concessions were made both by the company and its employes, so that for the time being there is no more talk of a strike.

Whether it is owing to the remarkable results of the recent elections or not, it is a fact, testified to by more than one electric manufacturing or supply house in Boston, that during the last few days there have been more out of town buyers and inquiries by mail than had been known for months before.

General News.

What is Going on in the Electrical World.

Hackettstown, N. J.—The electric light company intends to expend $9,000 in a new building and improvements to plant.

Milan, Tenn.—A franchise has been granted to N. J. Rogers, of Tonawanda, N. Y., to establish an electric light plant in this town.

Williamstown, Mass.—It seems certain now that the much talked of electric tramway between this place and North Adams will be built.

Americus, Ga.—The city council is considering the question of putting in an electric light plant to light the streets and public buildings.

Appleton, Wis.—Thomas Marston, of the firm of Felix & Marston, Chicago, has petitioned the city council for an electric railway franchise in this town.

Lincoln, Ill.—The electric street railway here has been sold to W. H. Patterson, of Bloomington, Ill., for $75,000. An extension of the line will be begun at once.

St. George, S. I., N. Y.—Application has been made to the board of supervisors to have the motive power of the Midland Railway changed to electricity.

Hackensack, N. J.—The plant of the Edison Electric Light Company was destroyed by fire on the 6th inst. The loss is about $30,000. The plant was well insured.

Nashville, Tenn.—A fire in the car shed of the Nashville Street Railway Company on the 4th inst. destroyed cars and other property valued at $19,000; fully insured.

Newark, N. J.—The Franklin township committee has granted the Passaic and Newark Electric Railway Company a franchise for a trolley road through the township.

Springfield, O.—The city solicitor has been instructed to draw up an ordinance concerning an electric road for which Messrs. Hanford and Webb have asked a franchise.

Port Jervis, N. Y.—The franchise for an electric railway in this town granted by the board of trustees has been accepted by the Suburban Street Railway Company.

Indianapolis, Ind.—The Jenney Motor Company have abandoned the idea of moving to Springfield, O. The big bonus to secure the plant did not materialize, it is stated.

Auburn, Ala.—The Opelika and Auburn Electric Railway is rapidly nearing completion and will be running trains into Auburn, a distance of seven miles, within three weeks.

East Liverpool, O.—The Ceramine City Electric Light Company's plant was burned on the 1st. Loss, $20,000; insurance, $8,000. The city is at present without electric lighting facilities.

Detroit, Mich.—James H. Talbot, W. R McLaren and Reginald A. Britt have filed articles of association of the Universal Electric Construction Company, with a capital stock of $25,000.

Geneva, N. Y.—The names of more than a hundred patrons have been secured for a new telephone service here, the annual rentals of which are to be about half those of the present company.

Hillsboro, O.—The electric light plant and gas works located here have been purchased by a new company, comprising J. R. Cook, E. W. Bixby and Harry Campbell, of Ironton; R. M. Dittey and J. B. Smith, of Hillsboro, and F. J. Picard, of Columbus.

McKeesport, Pa.—It is the intention of the Homestead and Highland Street Railway Company to extend their line to McKeesport. They will build the line through Munhall, Bellwood and Dravosburg, and connect with the traction line leading to this city.

New Orleans.—The New Orleans Traction Company, having experienced much difficulty in securing sufficient current from the Louisiana Light and Power Company for the proper working of their trolley cars, intend to erect a power house and put in a plant of their own.

Tower City, Pa.—A movement has been commenced for the construction of an electric railway through the Williams Valley, commencing here and extending through Williamstown and Lykens. The borough councils of the last two places have already granted the right of way.

Columbus, Ga.—The mules and dummies are to be dispensed with shortly on our street lines and a livelier and better system take their place. It is claimed that when completed the electric road now being constructed will be the best built and best equipped road in the South.

Gettysburg, Pa.—In the United States Circuit Court, on the 3d inst., the jury of seven rendered a verdict of $30,000 compensation to be paid by the Government to the Gettysburg Electric Railway Company for the taking of lands required to keep the historic battlefield intact.

Rutherford, N. J.—The Union Traction Company has been organized and an application for a franchise for an electric railway through Rutherford will be made at once, the aim of the company being to operate a railway from Newark to Hackensack. The main office of the company is to be at Rutherford.

Brazil, Ind.—The Interstate Telephone Company of Louisville, Ky., has organized a company here composed of thirty-five stockholders and patrons, who have subscribed 105 shares of $10 each, the parent company to hold the balance of stock. The company will proceed at once to put in an exchange.

Woodville, Mass.—An electric railway is projected between Woodville, Hopkinton and Westboro and $50,000 of the stock has been subscribed. B. G. Underwood, of Malden, and Arthur M. Bridgman, of Brockton, heavy subscribers to the stock of the Marlboro and Westboro line, are interested in the new road.

Bay City, Mich.—The organization of the Saginaw Consolidated Street Railway Company, with a capital of $150,000, gives foundation for the belief that the Eddy Electric Company, which is about to construct an electric road between Saginaw and Bay City, will have opposition. It is probable that the new company has been organized for the purpose of connecting the valley cities by an electric line.

Manchester, N. H.—Although a city of 50,000 population, Manchester is still using horses for its street cars, but a movement is on foot to get an electric line chartered at the next session of the Legislature. The president of the Manchester Street Railway has failed to fulfil his promise, made several times since 1892, to equip the street lines with electricity, and the people are growing impatient over his procrastination.

Pittsburg, Pa.—F. H. Thompson, superintendent of the Spanish-American Electric Company of Havana, Cuba, has been in town since last week to look after some special motors for his plant in course of construction at the Westinghouse works. Mr. Thompson's company a few months ago, to meet the increased demand for electric lights in Cuba, ordered an entire new equipment for the plant in Havana from the Westinghouse Company, and the work has been pushed as rapidly as possible.

Baltimore.—A company is organizing here to utilize the waters of the Susquehanna River in generating electricity. The plan is to locate an extensive electric plant on the shores of the Susquehanna near Conowingo, which is some miles above Port Deposit, and only thirty-five miles in an air line from Baltimore, from which power will be transmitted by overhead wires direct to this city, taking in the town of Belair on the way. Some forty-feet fall of water can be secured, and the power can be run up to 100,000 H. P. Negotiations are in progress with parties in Pittsburg for the necessary electrical machinery.

Norwalk, Conn.—The South Norwalk and Norwalk Electric Company, of which L. C. Whitney is receiver, has voted to offer its plant to this city for the original cost of the same, about $125,000. This is done for the reason that the city proposes establishing a commercial plant, and to place the company in a legal position to protest against such a scheme. The law, while granting the privilege to cities of establishing plants, specifies that such cities shall not establish such plants in connection with a commercial system without first buying the local plant. The case may go to the high courts, and will be watched with interest.

Lockport, N. Y.—The following business men have been selected as incorporators and directors of the Citizens' Mutual Telephone Company, which, it is proposed, will take the place of the Bell Company: Joseph A. Ward, W. W. Trein, Ald. A. H. Stevens, George W. Pound, Harrison S. Chapman, the Hon. Thomas Oliver, Dr. M. S. Kittinger, Frank B. McNeil, Ald. James Clifford, jr., T. H. Van Horn, W. T. Ransom and H. K. Wickser. Last month the common council directed the Bell Telephone Company to remove its poles from the streets within ninety days, refusing to renew the company's franchise because it would not reduce its rates.

St. Louis.—The city council will be asked soon to grant an electric railway franchise to the St. Louis and Southwestern Electric Line, George C. Fox president, A. E. Weiss secretary, and J. M. Wiener treasurer. The route includes all the important points in South St. Louis and also Forest Park.—If a bill to be introduced in the next Legislature is passed, amending the laws limiting the capital stock of a corporation to $10,000,000 by substituting $50,000,000, it is likely that the proposed scheme for consolidating all the street railways into one corporation will be carried out. The total capitalization of these companies at present is $18,962,000, with a bonded indebtedness of $16,050,000; the total mileage is 283 miles.

Montreal, Can.—The Dominion Government has secured the lease of an unoccupied island of the Hawaiian group for a landing place for the Pacific cable that is to connect the Australian with the American colonies of Great Britain. The proposition to lease the island was submitted to Secretary Gresham, who said that under the treaty of the United States with Hawai no interference with such an arrangement could be made. The Hawaiian Government is to grant a subsidy of £7 000 a year for a period of years. In return for this the cable company is to conduct a branch to Honolulu and only charge the following low rates for the transmission of messages: commercial business, one shilling a word; Government despatches, nine pence; press despatches, sixpence.

Houston, Tex.—The Washburn-Moen Company's representative here, speaking of the wire business in Texas to a reporter of the *Post*, said: "Formerly Houston and other Texas merchants were compelled to send to New York or some other Northern city for cable wires for elevators, for wire for springs, brooms, etc. Now, all this we have in stock, and so do the hardware merchants. An order for trolley wires for an electric railroad, for insulated telegraph wire, for wire mattress springs, for wire clotheslines, for weather-proof wire for electric plants, for magnet wire; in fact, for anything in the wire line, can be filled right here in Houston. A concern like the Washburn-Moen Company is located here because of the unsurpassed shipping facilities, as we can reach not only Texas but all of Mexico."

Denver, Col.—I. B. Porter and F. C. Williams, of Denver, and W. F. Elliott and D. S. Forney, of New York, have applied to the board of aldermen for a franchise for a new telephone company, the object being the organization of a company with a capital stock of $300,000 to furnish a complete telephone service for the city of Denver, its suburbs and the cities and towns of the State. The telephones used in business houses, which now cost $120 a year each, they propose to furnish at the rate of $60 a year, and the price of private residence telephones would be reduced from $60 to $40 a year. The applicants have a new appliance with which, they say, "there will be no need of asking central for a better connection in order to hear distinctly, no matter how great may be the distance between the parties using the telephone."

The Mather Electric Company.

The Mather Electric Company of Manchester, Conn., report the following sales of apparatus for the month of October. The company now has orders ahead for three months and is operating its entire plant overtime until 10 'clock every night:

Hartford and West Hartford St. Ry. Co., Hartford, Ct. (2d order)	180	K. W.	500 v.	Generator
Hartford and West Hartford St. Ry. Co., Hartford, Ct. (3d order)	180	"	500 v.	"
Bloomington City Railway Co., Bloomington, Ill	100	"	500 v.	"
Amory Mfg. Co. Manchester, N. H.	80	"	120 v.	"
Chas. R. Lewis Clothing Mfg. Co., Belleville, Ill	30	"	120 v.	"
Stamford Hotel, Chicago	45	"	120 v.	"
John Jermyn, Scranton, Pa	100	"	300 v.	"
Southwest Va. Improvement Co., Pocahontas, Va	60	"	220 v.	"
Somers Fuel Co., Belle Vernon, O.	60	"	220 v.	"
J. Holt Gates, Chicago	60	"	220 v.	"
J. Holt Gates, Chicago	30	"	120 v.	"
J. Holt Gates, Chicago	100	"	500 v.	"
Burtis & Howard, Minneapolis	11	"	220 v.	Dynamo
Stanley Elec. Co., Pittsfield, Mass.	2	"		Manchester Exciter
Jones & Lamson Machine Co., Springfield, Vt	350	light		Dynamo
Warren Shaw & Co., South Peabody, Mass	250	"		"
Lewis Anderson & Co., Skowhegan, Me	600	"		"
George Pappert Mfg. Co., North Milwaukee, Wis	150	"		"
H. B. Coho, New York City	450	"		"
Cobb, Bates & Yerxa, Fall River	600	"		"
Chambers Elec. Light & Power Co., Truro, N. S. (6th order)	600	"		"
Ohio State University, Columbus, Ohio (2d order)	16	H. P.		Manchester Motor
Sheriff of Hampden County, Springfield, Mass	5	"		" "
Ætna Electrical Works, Hartford, Conn	6	"		" "
Chas. R. Lewis Clothing Mfg. Co., Belleville, Ill	5	"		" "
Harry S. Anderson, Springfield, Mass	600	ampere		Spec. Dynamo

Shipments consisting of further October orders and former orders:

Bartram Hotel, Philadelphia	2 45	K. W.		Dir. Cor. Machine
New Pittsburg Coal Co., New Pittsburg, Ohio	60	"	220 v.	Generator
Morris Coal Co., Sand Run, Ohio	60	"	220 v.	"
Henry R. Worthington & Co., Brooklyn, N. Y	45	H. P.	220 v.	"
Jones Bros. Electric Co., Cincinnati (7th order)	50	"	220 v.	"
Conn. River Paper Co., Holyoke, Mass	700	light		Dynamo
Grenada Hotel, Chicago	450	"		"
Leafe Bros, Winchester, Va	50	"		"
Major & Loomis, Hertford, N. C.	25	"		"
George W. Furbeck, Chicago	250	"		"
Badger Lumber Co., Kansas City, Mo	100	"		"
Henry R. Worthington & Co., Brooklyn, N. Y	600	"		"
Diamond Machine Co., Providence, R. I	250	"		"
North Packing and Provision Co., Somerville, Mass., (3d order)	1000	"		"
H. S. Sands, Fairmount, W. Va.	450	"		"
Earl Knitting Mill, Northville, N. Y	75	"		"
Bay State Distillery Co., East Cambridge, Mass	350	"		"
Phelos Publishing Co., Springfield, Mass.	20	H. P.		Manchester Motor
Machinery Supply Co., Los Angeles, Cal	5	"		" "
Conn. River Paper Co., Holyoke, Mass	2 15	"		" "
Meriden Britannia Co., New York City (2d order)	5	"		" "
Machinery Supply Co., Los Angeles, Cal	3	"		" "
Machinery Supply Co., Los Angeles, Cal	10	"		" "
B. F. Sturtevant & Co., Chicago	10	"		" "
Electric Construction and Engineering Co., Detroit, Mich	5	"		" "

Catalogues of the Week.

The Partridge Carbon Company, Sandusky, O., issue a pocket catalogue giving prices on all sizes of carbon brushes for all the standard dynamos and street car motors. The lists are comprehensive and convenient to have always at hand.

The Metropolitan Electric Company, Chicago, always up to date in its catalogues, sends out a very comprehensive list and description of the railway supplies carried in stock, covering 204 pages. There is a good index, always a valuable feature. From the Metropolitan Company also comes a pocket catalogue of insulators for every conceivable use.

From the Sperry Electric Company, Cleveland, O., comes a nicely illustrated and well printed catalogue of Sperry Railway Apparatus. A great deal of the space is devoted to the electric brake concerning which Mr. Sperry recently read a valuable paper before the A. I. E. E. There are added some expressive testimonials as to the efficiency of the brake in practice.

INCORPORATIONS.

The Citizens' Electric Light and Power Company, Terre Haute, Ind.—to manufacture, use and sell electric light and power. Capital stock, $50,000. Promoters: Russell B. Harrison, Terre Haute; Michael E. Burke, John G. McNutt.

The Minnesota Harrison Telephone Company, Minneapolis, Minn.—to operate in Minneapolis, construct telephone apparatus, operate telephone lines between cities, and get out patents. Capital stock, $250,000, with a limited liability of $50,000. Incorporators: Charles H. Maxey, Thomas F. Hurly, W. A. Edwards, George E. Maxwell, B. W. Taylor, George E. Hays, of Minneapolis, and W. N. Stewart, of St. Paul.

The Mt. Vernon and Walhonding Electric Railway Company, Mt. Vernon, Ohio. Capital stock, $50,000. Incorporators: Fred T. Botzum, W. F. Ballinger, O. D. Bunn, Desault B. Kirk, Harry D. Critchfield, Harry C. Devin.

Belvidere Telephone Company, Belvidere, Ill.—to furnish telephone and electric service and electric supplies. Capital stock, $5,000. Promoters: W. M. Mareau, Omar H. Wright, Jr., Jno. G. Tripp, J. R. Balliet.

The Traders' Annex Company, Clarksburg, W. Va.—to erect and own buildings, etc., construct electric plants, street railways, etc. Capital stock, $1,000,000. Promoters: T. M. Jackson, D. R. Morgan, W. B. Maxwell, Clarksburg.

E. P. Electric Company, Chicago, Ill.—to manufacture and sell electrical machinery and electrical appliances of all kinds. Capital stock, $500,000. Promoters: Edw. I. Frost, Chas. W. McCorkle, E. W. Cramer.

Normandy Gold Mine (incorporated in W. Va.), Amador City, Cal.—to mine and manufacture; lease mines, operate same, build tramroads, waterworks, electric plants, etc. Capital stock, $100,000. Promoters: Stephen H. Emmens, Chas. A. Week, L. G. Haskin, Amador City.

The People's Electric Company, Valparaiso, Ind.—to maintain a light, heat and power plant, etc. Capital stock, $30,000. Promoters: Geo. Marpole Willis, Otis E. Turner, Jas. A. Cummins.

American Iron Car Company (incorporated in W. Va.), New York, N. Y.—to manufacture and construct freight, passenger and electric railway cars, etc. Capital stock, $5,000, min. Promoters: Carroll Sprigg, Q. A. Gates, Henry Briderman, E. L. Pierson, New York City.

The Monarch Gas Engine Manufacturing Company, San Francisco, Cal.—to manufacture and deal in gas, gasoline, electric and steam engines and accessories; operate a general machine shop. Capital stock, $20,000. Promoters: J. A. Frost, Oakland, Cal.; W. S. Scott, S. W. Powell, San Francisco.

The Forest City Electric Light and Power Company, Forest City, Ia.—to operate a plant for electricity, light and power. Capital stock, $25,000. Promoters: M. Barton, C. H. Kellogg, J. F. Thompson, of Forest City.

Jenney Electric Conduit Company, Chicago, Ill.—to construct railway tracks, etc. Capital stock, $5,000,000. Promoters: L. A. Farnsworth, Jos. M. Hill, Chas. S. Marshall.

The Delaware and Schuylkill Traction Company, Doylestown, Pa.—to construct and operate motors and cables or other machinery for supplying motive power to passenger railways. Capital stock, $50,000. Promoters: Wm. Jenks Fell, Faulkland, Del.; Robt. C. Fulton, Sam'l A. Hamilton, Philadelphia.

The Belding Electric Alarm Mail Box Company, Chicago, Ill.—to manufacture and vend the electric alarm mail box patented by Edw. Chas. T. Belding and improvements thereon. Capital stock, $25,000. Promoters: Edw. Chas. T. Belding, Thos. W. Saunders, C. Stuart Beattie.

The Mother Lode Power Company, San Francisco, Cal.—to manufacture and deal in power, light and heat produced by electricity, water, compressed air, steam or otherwise; transport, transmit and distribute light heat and power; build and operate water works, and deal in and operate mines, etc. Capital stock, $800,000. Promoters: J. F. Parks, Jackson, Cal.; Jackson Dennis, Sutter Creek, Cal.; Chas. D. Pierce, Oakland.

The Union-Traction Company, Rutherford, N. J.—to contruct street railways. Capital stock, $1,500,000. Incorporators: George S. Forbush, of Brookline, Mass.; Francis J. Callanan, Rutherford; Otis G. Burnap and Frank Gardner, Brooklyn; Louis H. Levin, New York; Henry C. Broking, Carlstadt; Theodore G. Hoster, East Rutherford, Edwin T. Galloway, Thomas G. Bell, John M. Bell, Collector Charles Burrows, of Rutherford, and John S. Forgotson, of New York.

The Wilder-Sloss Electric Hotel Call Company, at Chicago—to manufacture electrical devices. Capital stock, $250,000. Incorporators: Louis Stein Binswanger and Edmund R. Wilder.

The Secretary of State of West Virginia has chartered the Union Telephone Company of Parkersburg, W. Va., with an authorized capital of $150,000. The incorporators are: C. H. Shattuck, of Parkersburg; E. M. Gilkeson, of Romney; J. B. Finley, of Parsons, and F. S. Sherick, of Marietta.

ELECTRICAL PATENT RECORD.

Letters Patent Issued October 30, 1894.

ELECTRIC RAILROADS AND APPLIANCES.

528,149. Trolley-Catcher. Woodson D. Cobb, Fort Worth, Tex. Filed May 29, 1894.

528,205. Conduit Electric Railway. Julius L. Hornig, St. Louis, Mo., assignor of one-half to Theodore H. Wurmb, same place. Filed Feb. 19, 1894.

528,330. Conduit System for Electric Railways. John B. Linn, Cleveland, assignor of one-half to Oliver S. Kelly, Springfield, Ohio. Filed Dec. 9, 1893.

528,379. Closed-Conduit Electric Railway. James F. McLaughlin, Philadelphia, Pa. Filed May 10, 1894.

528,438. Safety Device for Electric Cars. John M. Kelly, Rochester, N. Y. Filed Nov 21, 1892.

528,465. Electric Machine for Railway Systems. Edward Deming, New York, N. Y., assignor of three fourths to Samuel Corn, Henry Corn, Adolph Kaufman and Isaac Stern, same place. Filed May 27, 1893.

528,477. Supply System for Electric Railways. Charles H. Harkins, St. Louis, Mo. Filed Dec. 9, 1893.

528,494. Closed Conduit for Electric Railways. William E. Stearns, Berlin, Conn., assignor, by direct and mesne assignments, of one-third to David L. Bradt, John P. Coghlin and Frank O. Plummer, Worcester, Mass. Filed April 7, 1894.

ELECTRIC LIGHTS AND APPLIANCES.

528,184. Electric-Arc Lamp. Rudolph Segerdahl, Chicago, Ill. Filed Feb. 26, 1894.

528,241. Electric-Lamp Shade. Edouard Vedovelli, Paris, assignor to Henry Guinard, New York, N. Y. Filed Aug. 4, 1894.

DYNAMOS, MOTORS, ETC.

528,204. Armature for Dynamo-Electric Machines and Method of Making Same. Thomas H. Hicks, Detroit, Mich. Filed July 14, 1893.

528,440. Reversing Mechanism for Electric Motors. John Mellen, Newport, Ky., and Nathaniel O. Goldsmith, Cincinnati, Ohio, assignors to Frederic C. Weir, Cincinnati, Ohio. Filed March 24, 1894.

BATTERIES.

528,286. Galvanic Battery. Martin M. Clark, Chicago, Ill., assignor to the Western Electric Company, same place. Filed May 27, 1893.

528,445. Secondary Battery. John E. Rhetts, Salem, Ind. Filed Nov. 22, 1893.

TELEPHONE AND TELEGRAPH APPARATUS.

528,345. Telegraph-Key. Christopher F. Sebring, Leeds, Mo. Filed July 2, 1894.

528,390. Mechanical Telephone. Jerome Prince, Milford, Mass., assignor, by direct and mesne assignments, to the Musical Telephone Company, same place and Saco, Me. Filed May 16, 1894.

SIGNALS AND SIGNALING APPARATUS.

528,245. Electric Railway-Signal. Adoniram J. Wilson, Port Chester, N. Y., assignor to the Hall Signal Company of Maine. Filed Nov. 21, 1892.

528,246. Electric Railway-Signal. Adoniram J. Wilson, Port Chester, N. Y., assignor to the Hall Signal Company of Maine. Filed Dec. 16, 1892. Renewed March 28, 1894.

528,441. Electric Signalling Apparatus for Block Systems. Matthew S. Reiley, Washington, D. C., assignor of sixty-seven ninety-sixths to Robert E. L. White, Geo. W. White, James M. White and Fred. R. Miller, same place. Filed June 13, 1894.

MISCELLANEOUS.

528,153. Electrolytic Apparatus for the Manufacture of Chlorin and Caustic Soda. Thomas Drake, Huddersfield, England. Filed June 30, 1894.

528,185. Automatic Electromagnetic Cut-Out. Lucius T. Stanley, Brooklyn, N. Y., and Alfred E. Braddell, Philadelphia, Pa., assignors to Henry B. Cutter, Philadelphia, Pa. Filed Aug. 22, 1893. Renewed June 1, 1894.

528,188. Electric Transformer. Elihu Thomson, Lynn, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Jan. 29, 1890.

528,189. Thermostat. David W. Thompson, Chicago, Ill. Filed Nov. 19, 1889. Renewed July 8, 1891.

528,243. Rheostat. Montgomery Waddell, Bridgeport, Conn., assignor to Montgomery Waddell, receiver of the Waddell-Entz Company, of West Virginia. Filed Sept. 6, 1893.

528,268. Ohmmeter. Arakelyan H. Armen, Lynn, Mass. Filed April 21, 1894.

528,273. Phonograph. Henri J. Lioret, Paris, France. Filed Dec. 20, 1893.

528,291. Underground Conduit. James F. Cummings, Detroit, Mich., assignor of one-half to Eugene M. Engelman, Milwaukee, Wis. Filed Jan. 10, 1894.

528,301. Art of Coating Electric Conductors. Albert F. Montgomery, Lincoln, R. I., assignor to Lawrence braham Lockwood, same place. Filed July 2, 1894.

528,322. Process of and Apparatus for Electrolytic Decomposition of Alkaline Salts. Hamilton Y. Castner, London, England. Filed Sept. 26, 1892.

528,430. Electromagnetic Switch. John G. Hartel, Keokuk, Iowa; Florence L. Hartel, administratrix of said John G. Hartel, deceased. Filed Dec. 2, 1893.

ELECTRICITY.

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N. E. L. A.—The next annual meeting of the National Electric Light Association will be held at Cleveland, O., February 19-21, 1895. Every concern interested in either lighting or railway work should be represented in the membership of this body, and should have at least one representative at the Cleveland meeting. The Secretary is Mr. Geo. F. Porter, 136 Liberty street, New York.

EDITORIAL NOTES.

An Electro-Medical Fraud Exposed.

ELECTRICITY has been from its first issue outspoken in its condemnation of the swindlers and cheats who are continually robbing the poor, the sick and the ignorant in the sale of so-called electro-medical appliances—swindlers who rely on the magic term electricity to humbug the public, trusting by reason of the undoubted popular ignorance of the subject to escape exposure and arrest.

Our warfare has been not wholly successful so far, partially from the fact that reputable journals have allowed their columns to be used by the advertisements of the quacks, but chiefly because the authorities of the World's Fair allowed a large number of these quacks to make extensive exhibits in the Electricity Building, thereby placing them, in the popular estimation, upon an even plane of legitimacy with the manufacturer of dynamos or other standard apparatus.

We succeeded in convincing the religious press and many other periodicals that the advertisements of electric belts, hairbrushes, insoles, etc., should be excluded; but there remained many who either were not convinced or who were willing to sell themselves at the rate of 50 cents a line to any fraud however flagrant. Chief among the latter class is the *New York Sun*, which has carried for a year past an advertisement of "Actina," an unqualified swindle, whose promoters could not escape the penitentiary if brought to trial.

Latterly the most conspicuous of these frauds has been the "Electropoise," on a par with "Actina" in that it possesses no capability of accomplishing any result whatever in its application, but which has acquired a higher standing than any of the others, because, as we suppose, its promoters have been of a higher class than Owens, Pratt, etc., belonging, as it were, to the aristocracy of swindlers.

We denominate the "Electropoise" an outrageous humbug and fraud in full knowledge of the fact that many intelligent and honorable people have testified over their own signatures to wonderful cures by its use. Testimonials of cures, however, can count for little in the face of facts like these:

The highest medical authorities state that any material oxygenation of the blood through the skin is an absolute impossibility by any conceivable method of treatment.

The highest electrical authorities state that the application of the "Electropoise" can have no possible effect upon any object, animate or inanimate.

Its power for benefit or injury is *nil.*

Whatever may be the differences of opinion as to the duty of the daily press in accepting or rejecting advertisements, some laws are firmly established, and no paper of any standing would carry an advertisement of a green-goods game, of a gold-brick swindle, or of a policy shop. Yet the sale of the "Electropoise" is a grosser fraud upon the public than any of these; and the *New York Sun* and other daily papers are carrying the advertisement.

But when we come to the religious press and the high-class monthlies there is no argument whatever as to their duty in the matter of choosing the advertisements which shall be admitted. The appearance of an advertisement in any of these publications is universally accepted as proof positive that the business so advertised is legitimate and has the sanction of the publisher. The *Sunday School Times* carries this principle so far that it agrees with its readers to refund any money paid to its advertisers upon proof that the goods advertised are not up to the representations made; not long ago this worthy journal was called upon to make good this guarantee and it did so without controversy.

When it is known that journals of this class, and monthlies like the *Review of Reviews* and the *North American Review*, have not only advertised the "Electropoise" but in some cases given it editorial indorsement, is it any wonder that the fraud has acquired a certain standing and that their swindling business has grown to enormous proportions?

We shall put a stop to all this; and we solicit the support of those who believe that frauds should not receive assistance even in the advertising columns of respectable periodicals.

But the refusal, at this late day, of newspapers to accept this concern's advertisements would not be sufficient to stop the swindling game. As long as they can use the United States mails in the promulgation of their nefarious enterprise, or even carry on an office business in the large cities, they will continue to prey upon the public.

We insist, therefore, that the postal authorities take this matter in hand at once, and that the New York Police Department make an investigation on its own account of the methods employed in this remarkable business. They will find all the well-known accessories of the confidence and green goods games—the stool pigeon, the capper and the bogus purchaser, the office boy rushing in to the manager to "borrow the last 'Electropoise' on hand" for shipment--a well-planned and well-executed scheme to cheat and rob.

As before stated, we accept as genuine the testimonials shown, but we cannot help wondering how many of them must rest under the same suspicion of self-interest as that of Gen. R. G. Dyrenforth, the rainmaker, who, according to Mr. Du Bois, the general manager, has received in the past two years more than $20,000 for legal services in the Electro-Libration Company's interest.

We shall welcome the trial of any libel suit which will give us an opportunity to make the facts in regard to the "Electropoise" a matter of legal record.

* * *

Does "Electrocution" Kill?

A great amount of space in the daily papers has been devoted of late to a bootless discussion of the question whether persons supposed to be killed by electric shock are really killed or not. We say a bootless discussion, because newspaper men cannot settle this question by argument, however sensational or brilliant their paragraphs. They might, of course, undergo the requisite treatment, and thus forever solve the problem, but we doubt if even such a queen of enterprise as Meg Merrilies would take a current of 2,000 volts and ½ ampere and trust to D'Arsonval or Gibbons or anyone else for reanimation. If she, along with some others of the *World's* specialists, would try the experiment, be "killed" and come to life again, they would at least earn a right to live.

Electricity believes that the electric current kills, and that it kills with comparatively little pain as applied in cases of capital punishment in this State. We do not think the best machine was chosen for the purpose, and hold that a direct current machine producing 2,500 or 3,000 volts would have been more effective.

However, we agree that all possible experiments should be tried in the resuscitation of the condemned men. A score of men are accidentally killed by the current where one murderer gets it. If some method of treatment can be devised for reviving the innocent men who have been in contact only a fraction of a minute, the experiments would be of great value to humanity, regardless of the fate of the murderer who is brought back to life after suffering the mental torments of the damned. On this ground we are distinctly in favor of the experiments.

There appears to be no legal way in which these experiments may now be conducted on the bodies of the murderers who are killed by the current in this State, but there ought to be no trouble in getting a law passed providing for them very early next year. At present there are several systems of resuscitation advocated by eminent men, and they should all have a fair chance. The case of Mr. J. E. Cutler, of the Stanley Company at Pittsfield, who recently got an accidental shock from wires carrying 4,000 volts, and who was revived after a few minutes by the D'Arsonval treatment, is not, it must be borne in mind, analogous in any degree to that of the State punishment. The accidental contact was of only a second's duration, whereas the State treatment is prolonged for ten minutes or more. In the latter the subject gets the equivalent of thousands of sledgehammer blows, while the former fortunately escapes with comparatively few.

It must be remembered that it is not the *voltage* that kills, but the *quantity* of current that passes through the body, and this is as dependent upon the resistance as it is upon the voltage. As regards the normal resistance of the body, long series of experiments have failed to give sufficiently concurrent results to enable us to say safely what it may be in any particular case, or to draw the line beyond which the voltage will be sufficient and below which it will not be sufficient to force enough current to produce fatal results. When we come to accidental contacts, we introduce another unknown factor in the extraneous resistances of the boots, the floor upon which the person is standing, the nature of the contact with the wire, etc., which may be and usually is in such cases a greater controlling factor than the resistance of the body alone. For instance, a man having rubber boots on and standing upon a dry floor might catch hold of a wire carrying a current of 10,000 volts without inconvenience, whereas the same individual in his bare feet, upon a damp floor, might be killed by accidental contact with a wire charged with 2,000 volts

But let us have all the experiments possible, and let the question be forever settled. If one unfortunate lineman or other honest worker can be brought back to life by the promulgation of knowledge on the subject, it is worth all the efforts of the best men in the profession.

As to the propriety or impropriety of using a dynamo machine to kill murderers, and as to the degree of pain which the victim suffers, there is a great deal of sickly sentimentality. The science of electrics is not disgraced, and the feelings of the murderer should not be taken into consideration. The very essence of capital punishment is that it should have a deterrent effect on those liable to commit murder; and we doubt if the gallows or guillotine can be improved upon for this purpose.

But if the people want the dynamo to do the work, Electricity sees no harm in it to the science or to the trade.

Under the Searchlight.

Views and Opinions on Timely Topics.

Electricity as a motive power is now used on every street car in the city of Buffalo, the last horse car having been taken off the Jefferson street line on Saturday night, November 10, and from the streets of Buffalo forever. How many cities in the world can give as good an account of themselves?

* * *

Mayor W. L. Strong will have the appointment of an entirely new Board of Electrical Control in this city. We submit that the electrical interests are entitled to representation on this Board, which they never have had. And inasmuch as Mr. Strong is something of an electrical man himself, we have no doubt he will see things just as we do, appointing not only one but three commissioners of electrical training and experience.

* * *

We are informed on high authority that the price in the recent sale of 300 car equipments by the G. E. Company to the Yerkes system in Chicago was $600 per car. This makes business, of course, but how about profits?

* * *

The $2,500,000 mortgage given by the Portland General Electric Company to the Old Colony Trust Company of Boston has been released of record.

* * *

According to the law as at present interpreted, the Edison lamp patent has expired and any concern in the United States is at liberty to manufacture incandescent lamps—if they know how.

* * *

The employees in the G. E. factories in Lynn have just been treated to another cut in wages amounting to from 10 to 15 per cent. This is the third reduction during the last six months. The men bear it heroically, well knowing that work is scarce and winter approaching. Reductions in wages don't generally come when business is rushing or firms are making money.

* * *

The failure of the electric clubs throughout the country to fulfil their missions has rendered the establishment of headquarters of another sort desirable in all our larger cities. Without any particular effort being made to accomplish this result in New York, headquarters have been established by common consent. At lunch time a large proportion of the active men in the business are always gathered in the well-known restaurant of Nelson & Company in Cortlandt street, and out of town visitors are fast learning that it pays to drop in there at this time. Up town the lobby of the Imperial and the café of the Grand Hotel are equally well recognized. Thus the main purposes of an electric club, both downtown and uptown, are accomplished without the troubles and the worry which the official organization caused.

* * *

Mr. R. T. McDonald was one of the few regular attendants of the horse-show last week, who cared more to see the horses than the display of humanity in the boxes. Horses are his hobby and his large stables at Fort Wayne are being continually recruited from the best that is offered at Eastern sales.

Mr. James H. Rodgers, a Toledo street railway man, says he was told that in New York recently he could buy good horses at a dollar a head. He also had a proposition from a Montana ranchman who offers 1,000 horses at $1,000. The same man has, he says, 700 mules he would be glad to give away. He has driven them out to starve on the prairie. This situation of the horse market is claimed to be due to the trolley system. Horse raisers may find fault, but we have yet to hear of a single protest from a retired car-horse.

* * *

Our esteemed contemporary, the *Electrical Engineer*, seems to have gotten into hot water on the Storage Battery question. Some time since, through the necessity of filling its pages with something—no matter what—it published an article from one manufacturer of storage batteries, pointing out the defects of rival apparatus and exalting the merits of his own. To be sure, no names were given in connection with the criticised batteries, but there might as well have been for they were easily recognized. Having printed this article, the editors are overwhelmed with letters from the manufacturers whose products were criticised, and they are publishing them too, as of course they are in duty bound. We fancy it was the office boy or the cat who passed the copy of the original contribution, for the editors could not have done so; if they did they won't do so any more, for this has been a lesson to them. Not long previous to the admission of the Storage Battery article in question, the editors of the same journal, the office boy or the cat editorially indorsed an electrical hairbrush, and they haven't ceased to kick the cat since. We wonder if the cat knows whether it is being kicked now for the electric hairbrush article or for the one on the storage battery.

* * *

It is not easy to foretell the consequences which may follow the death of J. Hood Wright either in the house of Drexel, Morgan & Co. or in the General Electric Company. Mr. Wright was the guiding spirit of the former concern in all their electrical investments. An entirely new policy may follow very quickly.

* * *

Our brilliant and witty contemporary, the *Western Electrician*, in its last issue comments upon a joke gotten off by the *Electrician* (London), which it quotes and goes one better by congratulating the joke thus :

> Speaking of the electric current in relation to health, a Chicago newspaper says that it knows of a woman who has "gained twenty pounds by the use of her battery." That is nothing : we know of a man who has gained thousands of pounds by other people using his battery.

This paragraph is simply a piece of frivolity, and is deliberately printed as such. Our contemporary not only can be, but is, humorous as well as profound. Sprightliness, judiciously controlled, is ever engaging, and so we reprint our contemporary's joke and congratulate it.

* * *

The Kind of Man He Is.

(From the Chicago Inter-Ocean.)

Dr. Alva Owen, president of the Owen Electric Belt and Appliance Company, is defendant in a bill for divorce brought by Sophia Mary Owen, who claims a common law marriage. She says she has been driven from her home and that Dr. Owen has left the city with a view to preventing her from securing any interest in his fortune.

* * *

The Prophecy is Fulfilled.

(From the Dundee Advertiser, 1835.)

Electricity, moreover, is destined for mightier feats than universal illumination.

* * *

Sure Thing.

(From the Toledo Bee.)

Electricity has come to stay.

THEY TRY IT AGAIN.

The G. E. Company Will Have a Coal-Cutting Machine at any Cost.

(From Electricity, November 7.)

Returning home, this shoe-peg expert [J. R. McKee, manager of the G. E. mining dept.] purchased a Jeffrey coal-cutting machine, sent it to the shop of his company and gave orders to build machines exactly like it in every particular. These orders were carried out. Before the G. E. Company got them on the market, however, the Jeffrey Company had produced a new type of machine, of double the efficiency, so that the G. E. mining department still finds itself out of the race as far as mining business goes.

Within the past week a draughtsman of the G. E. Company, under orders from Mr. McKee, was lowered into the shaft of one of the Pittsburg Fuel Company's mines at Pittsburg, and spent three days in making drawings of the new type Jeffrey machine, and the blue-prints are no doubt in the hands of the mechanics by this time.

And this from a company which has been vociferous and persistent in its cry of "pirate" and "thief"!

* * *

OUT OF BUSINESS.

The Result of Buying Mr. Haskell's Stock.

(Official Circular.)

For the greater convenience of business, the Pennsylvania General Electric Company ceases to do business as a separate organization after this date, but this office will be continued as a branch of the General Electric Company.

E. D. Mullen, General Manager.

Philadelphia, Pa.

* * *

Ruinous Bicycle Competition.

(From the Toledo Bee.)

It is a remarkable and somewhat startling fact that the street railroad plants of this city have depreciated in value fully $1,500,000 in the past two years. The cause, bicycles. Were it not for the fact that there are between 7,000 and 8,000 bicycles in use in Toledo, the street car interests would be worth fully $1,500,000 more than the lines will bring in the market to-day.

This statement is easier to make than to prove. It is put forth as a reason why the electrical railway systems of the town are not making money, and as an argument for consolidation. We would like our contemporary to furnish an equally striking reason why the lighting plants have not paid? Have the bicycle lamps made street lighting unnecessary ?

* * *

What They Say of Us.

Our esteemed contemporary and namesake, *Electricity* (London), says of us :

> "Electricity is one of the few papers which do not believe in the creation of useless and empirical units, and it gives good reasons for its opinions."

This is all true, and to show what a single independent journal can do when it has common sense on its side, it may be stated that although Electricity was the only paper on this side the Atlantic to raise its voice against the official adoption of the proposed new nomenclature for electro-magnetic units by the American Institute of Electrical Engineers, even the Committee on Units and Standards were convinced of their folly and smothered them so that they did not even come up for discussion before the annual meeting at Philadelphia.

* * *

We Suppose Our Blue Cover Lines the Carriage of the Kaiser.

(From the Richmond State.)

Electricity is being rather curiously applied to a new carriage just built for the German Emperor.

* * *

The Queen's English.

(From the Electrical Review.)

> "Japan has cheaper telegraph rates than any country in the world, provided the Japanese language is used."

Has Japan cheaper telegraph rates than Japan itself, or isn't Japan a country ? Be careful of your English, Brother Price, be careful.

Honest Folk and Their Customs.

We recently told of a new trolley system in Chemnitz, Saxony, the feeder wires for which were carried on arms extending out from the houses to the centre of the streets, the inhabitants objecting to the standard trolley pole. The houses are all of solid stone masonry.

A system has now been inaugurated, with popular consent, which dispenses with fare collectors. The customary box is placed at either end of the car, and passengers are expected to deposit their fare. If any one is caught cheating, his name is printed in the leading paper next day under the heading *drückenberger*—an untranslatable word denoting a combination of sneak and deadbeat. Chemnitz has a population of about 125,000.

* * *

The Alderman Was Very Frank.

During a recent squabble in the Syracuse City Council between the Highway Committee, the Lighting Committee and the Sewer Committee, as to which should report on the question of giving a franchise to the new Citizens' Electric Light Company, Alderman Matty was provoked to a burst of frankness which is refreshing. Speaking to the Sewer Committee, he said: "You people want a piece of this. Why not refer it to a committee of the whole and give us all a piece ?"

THE BATE REFRIGERATOR CASE.

Argued and Now Awaiting Decision.

The Bate Refrigerator case was argued at Washington last week before the U. S. Supreme Court, and a decision is looked for within a few weeks.

Counsel for the Bell Telephone and General Electric Companies were Messrs. James C. Carter, J. J. Storrow and Charles E. Mitchell; and for the Westinghouse Electric and Harrison Telephone Companies Messrs. Wheeler H. Peckham, Edmund Wetmore, Gen. B. H. Bristow and C. A. Aldrich.

All previous decisions of the United States Circuit Courts have been against the contention of the Bate and allied companies.

The chances are 100 to 1 that the Edison lamp patent and some of the important Bell patents will be declared expired.

Changes in the Westinghouse Staff.

The following changes in the officers of the Westinghouse Company have been made, taking effect at once :

Mr. W. F. Zimmerman, formerly assistant general manager, has been made general Eastern agent, with offices at 120 Broadway, New York.

Mr. W. C. Clark, formerly assistant treasurer and general agent, has been made assistant general manager, with office at Pittsburg.

Mr. George H. Lewars, formerly treasurer of the Consolidated Electric Light Company, has been elected assistant treasurer, with office at Pittsburg (to take effect December 1).

Mr. Albert Schmid, formerly superintendent, has been made general superintendent, and Mr. Philip Lange, formerly assistant superintendent in charge of the Newark factory, has been made superintendent of the Brinton Works.

The company has at present unfilled orders exceeding $1,500,000, which, with the current orders, will give full employment to the new works.

The Elwell-Parker Company.

The Elwell-Parker Company, whose establishment of an American branch at Cleveland was reported exclusively in Electricity several weeks ago, have turned out their first machine, a 150 h. p. generator, which was tested with satisfactory results last week.

An Electro-Medical Fraud.

ELECTROPOISE, GROSSEST OF THERAPEUTIC HUMBUGS.

The Electro-Libration Company and Its Abettors.

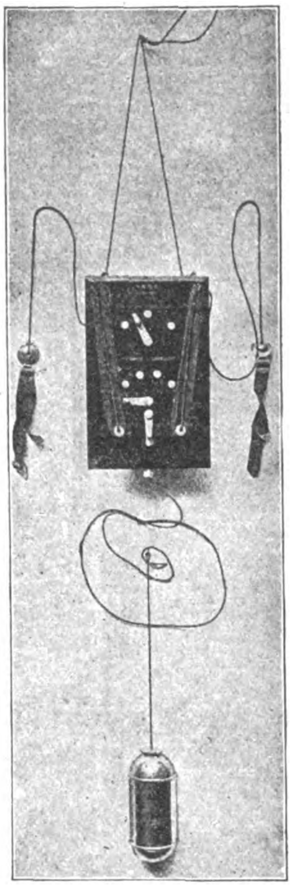
> "*The one discordant note in all this great display of genuine scientific and engineering work was found in the fact that in this same temple of science—in Electricity Building itself—naked imposture, quackery in the form of so-called electrical belts, hairbrushes, insoles and what not, had obtained a footing and stalked forth unabashed. No words of condemnation can be too strong to be applied to the parasites who, in the guise of healing and benefaction, succeed in extracting perhaps the last money from the sick and suffering for their worthless trumpery.*"—Prof. Elihu Thomson, in the *Engineering Magazine.*

In a recent issue of Electricity we editorially called attention to the fact that charlatanry was being upheld and indorsed by the acceptance of advertisements of the most barefaced frauds in the best of our literary and religious periodicals, and expressed our opinion that the religious press, by reason of its assumed high office, was by far the worst offender in this line. It seems that the organs of the church have pretty generally drawn the line at electric belts, hairbrushes, insoles and the like, the selling of which was decided by an English court (the Harness case) to be a criminal offence, but are pretty generally admitting and indorsing a still greater fraud in the so-called electropoise, a device utterly without merit, but for which such remarkable claims as a cure-all are made that it would seem that no sane man would accept it for a moment for anything other than what it really is—a fraud of the first water. The electric belt, against which these papers discriminate, has at least one claim to merit, viz., that it generally is capable of generating an electric current. The chief fraud consists in the claims made for it as a cure-all and its indiscriminate recommendation and sale for electro-therapeutic purposes. The crime consists in the false representations as to its healing and remedial properties, not in the claim that it is electrical. If the selling of such worthless nostrums, which really are what they claim to be but which do not do what is claimed for them, is criminal in the eyes of the law, how much more criminal is it to claim for an article that is not only not electrical, nor anything else for that matter, that it will heal by electrical means! Such an article as the latter is the electropoise, which has been highly indorsed by men who should know better, and is being advertised in the columns of some of the best of our literary magazines and the religious press generally. The selling of this worthless device under the claims made for it does not even stand upon as high a moral plane as the selling of lottery tickets, for the latter *may* draw a prize—at any rate, the purchaser buys with his eyes open and the knowledge that he probably will draw a blank. With the electropoise, actina and a host of other appliances there is not even the chance of a prize, and the purchaser buys with his eyes blindfolded by the religious and literary press. The selling of such appliances is on a par with the green-goods business exactly, except that the latter appeals to the cupidity of the unscrupulous, whereas the former plays upon the credulity of the sick, the poor and the infirm.

The United States Government has wisely closed the mails to the literature of the lottery manager and green-goods swindler and declared him a criminal who abets either by publishing advertisements or otherwise. Ignorance of the character of the advertisement is no excuse; it is the business of the paper when it takes advertisements to *know* their character, and it is assumed that the law is known. We believe that we can close the mails to every paper carrying such advertisements as the electropoise and actina, and that those responsible for their publication are indictable as participants in a crime.

In order to learn by word of mouth the claims made for this fraud, which stands almost unique in its brazenness, a representative of Electricity and another gentleman as a witness called at the office of the Electro-Libration Company in Madison Square one day last week. They found Mr. Du Bois, the agent of the company, seated at his desk talking to a gentleman. Immediately upon their entering, Mr. Du Bois, breaking off from his conversation, addressed the newcomers, asking them if they came to inquire into the merits of the electropoise. Our representative reports the conversation as follows:

"I told him that we had seen the advertisements in a number of papers and had come to inquire about the apparatus. He replied that he would be very glad to give us any information we desired. The electropoise, he said, was a most wonderful instrument and it had hosts of friends and also many enemies, but that it would accomplish all that was claimed for it there were thousands who would attest. He himself owed his life to it, and his wife and child had also been saved from the grave by its use. He wouldn't exchange the electropoise for the Fifth Avenue Hotel. Turning to the gentleman with whom he had been conversing he said: 'This gentleman has just begun treatment—he put it on his ankle last night for the first time.' He then removed an electropoise from its box and applied it to my wrist. The appliance consisted of a neat nickelplated cylinder about three inches long and one inch in diameter. In one end of this cylinder was fastened an ordinary flexible cord, the other end of which was attached to the metal clasp of a garter. The directions are to place the cylinder, which is called the 'polarizer,' in a vessel of cold water and the garter on the wrist or ankle next to the skin. The claim is that by cooling the polarizer and warming the 'treating-plate,' as the clasp is called, the body is 'polarized' and attracts to its surface the oxygen of the air which purifies the blood, etc.



Wall Electropoise.

"I kept the garter on my wrist throughout the conversation, which lasted about half an hour. There was, of course, no sensation whatever.

"'How long must a person keep this on for a dose?' I asked.

"'Well, that depends,' he replied. 'A robust person, such as you appear to be, might keep it on all night without ill effects, but some delicate people should not wear it longer than an hour or two at a time.'

"Q.—'Supposing in a given case you prescribed the use of the electropoise for only an hour at a time, for instance, and the patient should fall asleep and wear it all night, what would be the effect?'

"A.—'What! Sleep all night with it on without waking up? Why, it wouldn't hurt him, but might make him feel queer.'

"Q.—'What is in that cylinder—the polarizer—that gives it the remarkable properties claimed?'

"A.—'That is a secret that we do not divulge.'

"Q.—'You advertise that the body is brought into a "polar state." What do you mean by "polar?"'

"A.—'Well, I don't really know. That is what the scientific men call it, but the action is this: When you cool the polarizer and at the same time heat the treating-plate by the warmth of the skin, the treating-plate becomes polarized by heat. The air or oxygen of the air is at a lower temperature and has opposite polarity, and unlike poles always attract each other, so that the pure oxygen of the air is thus attracted to the body and absorbed and revitalizes the blood. That is the simple explanation of its action, and it works, too. It will cure Bright's disease—the doctors laugh at the idea, but it is a fact—and it will cure liver trouble, sure shot.'

"I fancy that Mr. Du Bois was trying to diagnose my case and discovering nothing else the matter thought it might be one or the other of these two diseases.

"My companion here asked: 'What would be the effect of putting the polarizer in hot or boiling water?'

"A.—'It would make you sick as a dog. We hired a nigger once to try it and it acted just as we knew it would—it nearly killed him.'

"Resuming my interrogatories, I asked:

"Q.—'To what do you attribute the wonderful properties of this appliance—to electricity?'

"A.—'Well, if I should say "yes" I would probably convey a wrong impression, because to the average mind electricity conveys the idea of a shock—you see there is no shock. And yet if I should say "no" I would also convey a wrong impression.'

"Q.—'Then, what is it?'

"A.—'It is really electricity—*thermo-electricity by induction.*'

"Here was the secret of the whole thing. It was 'thermo-electricity by induction,' whatever that was, so I looked wise and replied 'I see.'

"'Come here,' he said, leading the way into an alcove against the wall of which was hung an electric bell connected by wires with a hidden battery; 'I'll show you. I will place one end of the circuit on the polarizer and you put the other end on the treating-plate.' I did so and the bell rang loudly, as I expected, but in apparent surprise I exclaimed, 'Did that little cylinder generate the current to ring the bell?'

"A.—'No, the bell was rung by a battery which you can't see, but I wanted to show you that this flexible cord contains something that will transmit force. By connecting up the circuit through the cord the ringing of the bell proved that it could conduct or transmit electric force. It can also transmit other kinds of force, such as thermo-electric force.'

THE STOOL PIGEON.

"Apparently satisfied with this marvelous demonstration, I returned to my seat to continue the conversation, but had not been long seated when we were interrupted by the entrance of a newcomer who walked up to the desk, took a seat on the opposite side from mine and said, 'I want one of them electropoises.' 'All right,' said Du Bois; 'here it is, but what do you know about the electropoise?' 'I don't know nothing about it,' he replied; '*all* I know is that I want one. Will it cure asthma?' 'Sure.'

"Then ensued a long conversation between the two, evidently intended for my benefit, during which Du Bois told of many wonderful cures, and the stool pigeon handed over some money in exchange for the electropoise that had been wrapped up. I could plainly see the bills—there were three of them—one ten and two fives. Knowing that the advertised price was $25, I asked how much the instruments cost.

"'Twenty five dollars for these pocket electropoises and fifty for the wall instruments, such as that you see over yonder,' replied Du Bois, as he folded up the money and put it in his pocketbook.

"The stool pigeon then took his leave after having been invited to keep him (Du Bois) advised as to his progress. The stool pigeon hadn't told the agent what his ailment was. He had gotten out of the door when Du Bois called him back and asked, 'Do you know how to use the instrument?'

"A.—'Oh, yes, I guess so; the directions will tell, I guess.'

"The visitor having now departed I stepped over to examine the 'wall electropoise,' before referred to. It consisted of a black walnut board upon which were two multipoint switches—each with six points. There were two flexible cords and garters attached, and the 'polarizer,' which was considerably larger than that attached to the appliance I had on, was suspended in a cuspidore on the floor partly filled with water. Mr. Du Bois explained this as follows: The instrument itself was intended especially for hospitals and the two garters attached permitted the treatment of two patients at once. One of the switches was for regulating the intensity of the dose, which was accomplished by moving the lever to the proper point. The other switch was for disinfecting purposes and was regulated in a similar manner.

"Q.—'Do you really mean that this instrument will disinfect a room?'

"A.—'Certainly it will. It will kill every germ in it and destroy all odors.'

"Q.—'When the apparatus is operating does it give out any odor itself?'

"A.—'None whatever, but it will kill odors.'

"Q.—'Most other disinfecting agents have some odors of their own—I thought perhaps this one might have.'

"A.—'Well, *I can make a room smell* with this instrument so that you couldn't stay in it five minutes.'

"Q.—'How?'

"A.—'By turning the switch to the last notch and letting it operate for a long time.'

"Q.—'Who discovered this wonderful instrument?'

"A.—'Dr. Hercules Sanche claims to have discovered it, but I have always had my doubts about it. He claims to be a very scientific man, but I don't believe he knows any more about science than I do, and I don't know anything. I asked him once how he happened to discover it and he told me. I then said, "Now that you have told me how you discovered it I believe you." I had always thought he had stolen it from someone else. Its discovery was the purest accident.'

"Q.—'What were the circumstances of its discovery?'

"A.—'I won't tell you.'

"Q.—'Oh, I merely asked because I thought there might be a good story back of it all."

"A.—'There is.'

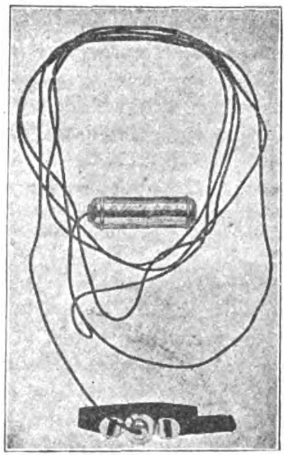
"My friend and I then left the office after having procured some literature and were accompanied down in the elevator by a boy with his arms full of electropoises.

"Whether or not this boy with his load was sent down in the elevator with us for a purpose it is impossible to say definitely, but that the number of persons being swindled by the Electro-Libration Company is enormous is certain."

A few days after the above occurrence Electricity endeavored, through a reputable druggist, to buy one of these appliances, but word came back that the company was entirely sold out for the present. A few days afterward another representative of Electricity called at the office, and after having secured an instrument and paid for it engaged Mr. Du Bois in conversation in regard to its merits. The same old stool pigeon game was played and, judging from the description, by the same party.

Before our second ambassador left he told Mr. Du Bois the object of his purchase.

Mr. Du Bois replied that we could not detect any current because there were no instruments in existence delicate enough except those possessed by their own company. He further said that the material inside of the polarizer cylinder was a combination of rare minerals that no chemist could analyze.



The Pocket Electropoise.

FIRST FRAUDULENT CLAIM.

Those familiar with charlatanism know these claims to be an old standby. It is a very old story with the quack that he possesses something that cannot be analyzed or otherwise tested, and it is one that seems to be perennially swallowed by the gullible public. As a matter of fact there never can be any basis for such a claim, and the claim itself is an unerring badge of charlatanry. To prove our point in this instance we will show later on that we have tested the electropoise, electrically, with positive results, and that we have analyzed successfully the contents of the polarizer.

SECOND FRAUDULENT CLAIM.

The Electro-Libration Company throws the charm of mystery around the appliance by stating that the contents of the cylinder is a secret and that it was discovered entirely accidentally. They also say that its discovery was due to Dr. Hercules Sanche, but advertise that it is manufactured under a patent granted to John N. Webb, March 31, 1891. If they are operating under a United States patent, there can be no secret in the device, for if there were it would not be patentable, and they are thus obtaining money under false pretences under the shield of the United States Patent Office.

The patent granted to Webb reads as follows:

"1. *A portable thermo electric battery, the ends, plates, or parts of which for treating or cooling are relatively great size to the intermediate connector, which is a suitable flexible connection, substantially as described.*

"2. *A plate for a thermo-electric battery, composed of a sheet of tin or other suitable substance folded upon itself in convolutions, provided with interposed separating pieces and a metallic binder, substantially as shown.*

"3. *The combination of a plate for a thermo-electric battery composed of a sheet of some relatively thermo-electro positive substance folded upon itself in convolutions, a relatively thermo electro" negative substance in the form of wire, and again a thermo-electro positive substance connected to the first by the wire, substantially as set forth.*

In his specification he insists upon the electrodes being large as regards the negative or conducting medium (the flexible cord). In the same place he says: "Instead of making both the electrodes in the same way, the heated one may be of smaller construction for attachment to the body, and the other, which is located in or at the earth or in ice, may be larger and of different form and metal or combination of metals, or a metal with a metal salt—for instance, a shell of copper containing sulphur and black lead or sulphide of mercury."

Thus we see from the patent, first, that the device is simply a thermo-electric cell. There is nothing new in this. Any two metals soldered together will constitute a thermo-electric cell. If we solder an iron wire to a heavily nickel-plated body of metal of any kind and heat the junction or cool it we will have an excellent thermo-electric cell, but the electromotive force of such a cell or of any other thermo-electric cell is so insignificant as to be practically negligible—it will not be more than a few thousandths of a volt.

In the second place, he does not patent any particular thermo-electric combination in his battery, but does patent a stated combination whose chief feature is that the ends or plates which are to be heated or cooled are relatively large as compared with the flexible cord. This feature, thermo electrically, has absolutely no value whatever, since the electromotive force of a cell, whether it be thermo-electro or galvanic, is entirely independent of the size of the plates. The electropoise as sold embraces this one feature, but does not embrace the features of the third claim, which is material.

The electropoise as sold does not consist "of a *sheet* of some relatively thermo-electro positive substance *folded upon itself in convolutions*, as required by the claims and shown in the illustration accompanying the specification, but consists of a thermo-electro positive cylinder of brass (nickelplated) with no convolutions whatever.

THIRD FRAUDULENT CLAIM.

In order to throw the halo of mystery around the implement its virtues are attributed to the contents of the metallic cylinder, which is said to be a mixture of two distinct mineral compositions that cannot be analyzed. There are no "mineral compositions" that cannot be analyzed, and the contents of the electropoise are no exception. We have analyzed them without the slightest difficulty and find that the cylinder is filled with a mixture of ordinary flowers of sulphur and graphite or black lead, probably introduced in the form of a paste and then dried.

Flowers of sulphur is worth about $1\frac{3}{4}$ to 2 cents per pound, and graphite say 10 cents. The contents of the electropoise upon which its virtues depend chiefly, according to the venders, is worth in the open market, therefore, not to exceed 2 cents. The cylinders in which the stuff is placed can be manufactured in quantity at not to exceed 10 cents apiece. The flexible cord—2 yards—can be bought at retail for 25 cents or less, and the garters are worth not over 5 cents apiece. We thus have the estimated cost of the complete outfit—2 + 10 + 25 + 5 = 42 cents. For this the Electro Libration Company is receiving $25 00 from the sick and poor, and the religious press and some of our best literary magazines are openly helping them to do it.

The cap of the polarizer when sawed off from the cylinder is a better thermo-electric cell, according to our tests, than the "polarizer" as a whole. The cap consists of nickelplated brass. Into the center of this the copper wires of the flexible cord are fastened. So that it is apparent that the contents of the cylinder or the special shape adopted have no material advantage over the simple connection of a copper wire to a nickelplated lump of brass. In fact the cap would be quite as good a thermopile if it were not nickel-plated at all.

FOURTH FRAUDULENT CLAIM.

We have shown by our own tests that the electropoise, when the circuit is closed by placing the garter on one wrist and touching the polarizer while on ice with a copper wire held in the other, gave a current of *four-millionths of an ampere*. The least current ever used by the medical profession for electro-therapeutic purposes is about *one or two thousandths* of an ampere, or about 250 *times* as much as the electropoise on careful test is found capable of giving. But as the electropoise is *applied* it can give absolutely *no current* to the patient, since the circuit is not closed. It is claimed for this device, however, that its action is due to "thermo-electricity by induction." There is no such thing as thermo-electricity by induction, so any virtue which is attributable to this hypothetical, high-sounding phenomenon must be equally hypothetical.

A further explanation, however, gives to the electrician an insight into what is perhaps meant. It is stated that the application of the device polarizes the body. It is true that if an electromotive force is generated anywhere in a conducting medium the two ends will become polarized. A thermopile such as the one under discussion will generate under the conditions an electromotive force of something like one-thousandth of a volt, and this might impart an insignificant polarity to the surfaces of the skin, but since the body itself may be considered as a thermopile, and the earth also is, and since every draught of air, or even the still air, is apt to be polarized in one or the other direction, the human system is living normally under a condition of electric stress, and oftentimes of much greater stress than that which can be created locally by the electropoise.

FIFTH FRAUDULENT CLAIM.

But admitting that the body is brought under new conditions by this application, simply for the sake of argument. If the body were polarized to a million volts, there would be no attraction or concentration of the oxygen on its surface. This is not mere theory, but has been well tested. Neither magnetic nor electrical polarization has any effect upon the composition of the atmosphere surrounding the polar surfaces except to abstract from it the dust that is at all times suspended therein. If, therefore, a polarized surface exerting a strain measured by hundreds of thousands of volts cannot abstract oxygen rom the atmosphere, what can be expected from one having a potential of but one-thousandth of a volt?

But supposing again, for argument, that the oxygen *is* thus attracted to the surface of the body, will any physician admit that the skin will so far surpass the functions of the lungs as to eradicate impurities from the blood that the latter, a specially designed organ for that purpose, fails to remove?

Or will any sane person, be he physician, minister of the Gospel or layman, admit that *any* remedy will cure or even alleviate such a diversity of ailments as the following?—[*]

Abscess,
Biliousness,
Bronchial troubles,
Catarrh,
Constipation,
Croup,
Dropsy,
Erysipelas,
General Debility,
Hip Disease,
Insomnia,
La Grippe,
Lumbago,
Morphine and Opium Habit,
Neurasthenia,
Piles,
Sciatica,
Sprains, Bruises,
Tonic Effect,
Vertigo,
Anæmia,
Bladder Trouble,
Bronchitis,
Cholera Morbus,
Consumption of the Bowels,
Dyspepsia,
Female Troubles,
Goitre,
Heart Disease,
Impotence,
Liver Trouble,
Malaria,
Nausea,
Nerv. Prostration,
Old Wound,
Pulmon. Troubles,
Scrofula,
Sunstroke,
Tonsilitis,
Yellow Fever,
Asthma,
Blood Poison,
Cancer,
Colic,
Coughs and Colds,
Diarrhœa,
Eczema,
Fever,
Gout,
Indigestion,
Kidney Trouble,
Locomotor Ataxia,
Measles,
Nervousness,
Neuralgia,
Paralysis,
Rheumatism,
Spinal Disease,
Syphilis,
Varicose Veins,
Aphonia.

Is not this list enough to condemn the thing as an arrant fraud? Does it need any investigation to stamp the whole scheme as a cheat?

It is worse than the Louisiana lottery. It is more criminal than the bunco or the green-goods business, and yet the very organs of the church are assiduously engaged in promoting this fraud upon the innocent and suffering who should look to them for protection. Avowedly engaged in the propagation of truth, they are prostituting their columns for gold—through ignorance, perhaps, but through inexcusable ignorance nevertheless—to the propagation of a lie.

Among the more prominent religious papers that have thus far come under our notice as giving space to the electropoise are the following:

The Churchman,
The Evangelist,
The Christian at Work,
The Examiner,
The New York Observer,
The Christian Nation,
The Sunday School Times,
N. Y. Christian Advocate.

That these sharks appreciate the assistance that can be rendered them in their nefarious occupation by the religious press is made evident by the number of them whose columns they are using. The *New York Observer* is given special prominence by them, by the printing and circulation of an editorial which appeared in its issue of February 22, 1894, heartily indorsing the electropoise.

POSTSCRIPT.

At the time of our purchase of the electropoise, Mr. Du Bois stated that the Smithsonian Institution had given the Electro-Libration Company a 12-page typewritten certificate stating that the Electropoise was a "scientific instrument of great value," and that either the Smithsonian Institution or Gen. Dyrenforth would furnish us with a copy.

We have received the following denial, which is conclusive:

S. P. LANGLEY,
Secretary.
SMITHSONIAN INSTITUTION,
WASHINGTON, D. C., NOV. 19, 1894.

MR. B. E. GREENE, Publisher of ELECTRICITY, New York.

DEAR SIR: The Secretary directs me to acknowledge the receipt of your letter of November 14, and to ask if you will be good enough to advise me under what circumstances it was reported that the Smithsonian Institution had given out a statement highly recommending the "electropoise" as a scientific instrument. Several inquiries of this kind have recently been made, seeming to indicate that some statement to this effect has been printed, and as it is entirely unauthorized, I am desirous of ascertaining how it originated, in order that the report may be contradicted, if necessary. The Smithsonian Institution gives no recommendations of this character. Very truly yours,

W. C. WINLOCK,
Assistant in Charge of Office.

A Resurrected Chapter in the History of the Invention of the Telegraph.

BY G. WILFRED PEARCE.

Among the grand army of charlatans who have moved across the stage of life since Benjamin Franklin laid the foundations of electrical industries we rank the late Samuel F. B. Morse as a Grand Master of Peter Funkism. Few well-informed Americans of his day recognized him as an inventor of the electric telegraph, and Europeans laughed his pretensions to scorn, but he nevertheless basked for awhile in the sunlight of popular favor. Morse's pretensions have been so well exposed by Mr. Vail in a series of articles in ELECTRICITY that it is useless to say another word about the case as it stands upon the testimony of persons living in the United States, but there is a chapter in Morse's life through which he drew a blue pencil, and never allowed it to be printed, and that is the story of his visit to Europe to "bluff" the Emperor of Russia, the King of Prussia and other potentates to pay him something for his alleged inventions in telegraphy. He was examined before competent officers of engineers in Paris, and was obliged to admit that he was not the original inventor of the telegraph, and that the apparatus which he erected in the University of the City of New York was simply a copy of an apparatus which he had seen at Spithead, England, and that the apparatus used in the line between Washington and Baltimore "was a modification of my apparatus used in the University of New York, but the practical apparatus contained the germ of my ideas, though a Mr. Vail contributed some mechanical devices that were approved by me." During his examination, Morse claimed that he conceived the telegraph when a passenger on the ship "Sully" bound from Havre to New York in October, 1832, but did not set about making apparatus until 1835, when there were long lines of telegraphs in France which were better than Morse's and equipped with almost all the devices which Morse attempted to use before Vail appeared on the scene and put the American lines into working order.

The examination of Morse in Paris was a cold blanket for him, but he decided to ask the Russian Ambassador to investigate his inventions and petition the Emperor of Russia to compensate him for the use of his devices. A commission was appointed and evidence was taken in 1857, and at the conclusion of the committee's labors a report was sent to Count De Nesselrode, who informed Mr. Morse's attorney that the Emperor was satisfied that the lines built in Russia in 1841 were on the same principles as Morse's, and that the inventors were Russian and French subjects. A supplementary report on the subject made by Baron Meyendorff to the Emperor stated that Mr. Morse was not the inventor of the electric telegraph used in America or elsewhere.

Like Japhet in search of a father, Morse toured through Europe, knocking at the doors of kings and queens, and never coming within an ace of getting anything until on the pleasant banks of the Bosphorus he met a high dignitary of the Sublime Porte who had a pull with His Highness Sultan Abdullah Mejid Khan, who was graciously pleased upon the receipt of $100.00 to confer the order of Nishan Ifftihar—Order of Glory—on his "trusty and well-beloved brother, Samuel F. B. Morse, of New York, for inventions of scientific writing apparatus."

From Turkey the persevering Morse went to Vienna and Berlin, where the royal engineers had no trouble in proving that he was not entitled to honorable mention or compensation for anything used in telegraphy.

From Berlin he journeyed to Paris and wrote a memoir in which he wailed over the fact that the crowned heads of Europe had no regard for the patents issued by the United States of America, which then as now are hardly worth the paper on which they are written. This pamphlet is very rare indeed, only one copy being in America—in the library of the American Society of Civil Engineers. It was issued exclusively for use in Europe and was printed in Paris at a time when Morse was smarting from the castigations of foreign engineers, who regarded him as a man who had pirated the inventions of worthy men.

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[*] This list is only a partial one of the diseases claimed to be cured by the application of the electropoise. It is taken from the advertising pamphlet of the Electro-Libration Company.

Conduit Electric Railways*—II.

Is There a Solution of the Problem?

BY JOSEPH SACHS.

Another class or system combines the magnetic arrangement of surface contact with the electro-magnetic. One of these is the Siemens system. Contact plates are used, and the switching mechanism therein consists of a pivoted lever which is first attracted by the magnet on the car and after the plate has been connected the current passes around a coil of wire on the lever and magnetizes it as long as the car is in contact with the plate.

There is another system devised by Lieut. Patten in which practically the same method is adopted. The switching device is so arranged as to improve the magnetic circuit. A separate contact rail is used.

Next we have what is perhaps the latest attempt in the surface contact system, by Messrs. Johnson and Lundell. It is very similar to the system shown previously, in which the magnetic switches are all grouped together, but a sectional rail is used instead of contact plates.

This system possesses various points of interest. Its chief peculiarity is that the car is also equipped with a storage battery, so that in case the brush under the car loses contact with any section of the contact rail the car is simply operated by the storage battery. The battery is also used to actuate the magnetic switch if it should be de-energized. The inventors claim various advantages in combining the storage battery with a system of surface contact.

Other surface contact systems have been devised by Gordon, Pollak and Binswanger, Shuckert and others. In the last named system iron filings are used as the switching medium in the same way as the levers are used in one of the systems described.

I will not dwell on the various points of advantage or disadvantage of the various surface contact systems. The claim put forth by their promoters is that they dispense with the open slot and can be installed cheaper than any such system. However, on the other side we have the difficulty of keeping down the leakage of the section that may be alive, the complicated mechanism, the many parts, and the uncertainty of action which always attends the operation of a number of small mechanisms under the conditions. This would seem to seriously defer the ultimate success of such systems.

Now we come to another class or system—there are many of them—in which the open conduit is used, but instead of having a continuous wire there is a sectional conductor—that is, only a section of the contact conductor is connected with the supply wire, and magnetic, electro-magnetic or mechanical switches may be used. We could, for instance, take any of the sectional conductor systems which I have shown you and place the contact rail or plate within a slotted conduit.

Various systems of this kind have been devised in which the sections of contact wire were operated by electro-magnetic switches. Systems of this nature have been devised by Mr. Wheeless and others. The switching of the various sections, plates or contact points can, however, also be accomplished by mechanical devices operated by the moving car. Many of these have been devised and tried.

In the Lawrence system a mechanical switch box is located at intervals, and the contact rail is composed of small T rails supported on a pivoted lever one end of which is connected with the switch piston. The trolley comes down upon the conductor and, by depressing one end of the lever supporting the rail, shoves up the lever and pushes in the switch rod, making connection with the main wire. After the collector has passed the bar springs up again and connection is broken in the switch box for that section.

The Muncie-Coles system was experimentally tried some time ago at New Haven. In this, instead of using a continuously depressed rail a number of switch boxes are used and the contact points are depressed by a long plow on the car. The conduit is very small and simply covers up the boxes.

A system which was recently exploited and tried at Coney Island presents a combination of ideas, but, as far as I can understand, it is also fundamentally due to the very fertile brain of Mr. G. T. Woods; it is practically the same as the Muncie Coles, but the very great advantage of this is that the switching mechanism, instead of moving up and down, moves on a pivot. The conduit used was very roughly constructed, simply made of boards. As the shoe on the car comes along it pushes the arm aside and throws it into connection with the main line conductor inside of the box. The shoe is flexible and so arranged that it will conform to all the irregularities in the slot in the conduit. An experimental road was built at Coney Island, and from results published in a Paper read before the American Institute of Electrical Engineers I consider it to possess a number of good points.

A system devised by Mr. Frank H. Ashley is much the same as the Lawrence or any other of the sectional conductor systems operated mechanically. It consists of a conduit, a sectional flexible rail, the supply conductor inside of a jacket, and as the connector comes along it presses up each section of the conductor and throws it in connection with the supply wire.

Now, these various forms of sectional conductor open-slot conduit systems possess, in my mind, very little advantage over the continuous wire conduit. You have in the open conduit the chance for getting mud, slush and dirt therein, and you must have a fairly large conduit.

Next we come to a very peculiar system. In this the inventor has attempted to bring the conductor, not in the conduit, not on the surface, but he has gone to the other extreme and says, let me bring it above the surface and I will have it clear and sure. So he constructs a slot parallel to the rail, along the roadbed, and places adjacent to that slot a number of switch boxes, having long arms, the contact point at the end of which runs across the slot. On the car is a plow, which projects down into the slot, and also a similar plow at the other end, and a connection or contact bar between the two plows. The plow goes down into the slot, catches one of these arms and raises it up. While the lever is raised in connection with the bar, current is supplied from that particular switch, and then after the car has passed by the raised contact the contact simply drops back again, but another lever is always raised before the last is dropped. This would be very good if we always had clean and clear streets and no mud, slush, dirt or snow; but inasmuch as the system has not yet been tried I cannot say whether it will be able to operate against these or not.

In another form of raised sectional contact system, devised by Mr. Henry, the contact device is located in a box in the roadbed, and instead of having a mechanical device we have an electro-magnetic device. A long magnet under the car attracts a plug in the box to it and makes contact therewith. After the car has passed the plug drops back and out of connection. The raising and lowering of the plug causes it to be connected and disconnected with the supply wire. The same points hold good with this system.

There is another form of raised contact system which is an exceedingly odd thing. This invention has a slotted conduit and puts therein a flexible cable, which is supported on cross bars. As the car goes along it raises up the flexible cable out of the slot and over rollers under the car, and after the car has passed it drops back.

Now we come to the last class. This is what is called the induction system, in which a number of primary coils are located at the regular points along the line, and upon the car is located a secondary coil, brought into such relation to the primary that a current is induced in the secondary from the primary. Although we may have the alternating current motor the system would be very inefficient and costly. [The system shown was by Mr. Dewey.] The primaries are wound upon U-shaped cores, imbedded in the roadbed with the two ends up. The long core on the car is also U-shaped; each end is a long brush which comes into intimate contact with the ends of the U in the street. The brush makes contact with a primary core before it leaves the last, and in that way a continuous alternating current is induced and the car is supposed to move; it has not as yet, though.

Now, as you see from the vast variety of possibilities and probabilities that I have shown, the solution of the conduit electric railway problem is not at all limited, and all you have to do is to pay your money and take your choice; but the peculiar part of it all is that there is not much choice to make, because apparently nothing has ever been evolved—nothing commercially practical—from any of the vast variety of material I have shown you except the plain, everyday open conduit and the continuous wire. That simply means that it has many points of superiority, is actually in operation, and nothing else has ever operated. There is such a system in operation at Budapest and at Blackpool, England, but it is doubtful whether either of these systems can be made operative in this country. The climatic conditions are different, and it is doubtful whether our American streets are quite up to those streets in Budapest in which one of the systems is in operation.

Various advantages are claimed for the different systems that have been suggested as a substitute for the open-slot conduit. They may obviate some of the disadvantages of the open-slot conduit with the continuous wire; they may claim to possess certain advantages in the way of costs, and other considerations which are even less apparent than that of cost, but they have other objections, and very strong objections, which, I think, put them far behind any open-slot conduit system, although I do not mean to say that such systems, that is, those other than the open slot conduit, cannot be made operative.

But let us return to the open-slot conduit systems that have been tried and installed. What do we find? We find, in the first place, a very small conduit, poorly constructed; the wires are located in very poor positions and badly protected; the drainage is exceedingly poor and the voltage is exceedingly high. The last is the case in the attempts that have been made and have failed, although in the attempts that have been made and succeeded the voltage is low—being about 300 volts. The aim has always been to produce a cheap system, a system which will compete with the trolley. That is a very desirable aim, but not one that is absolutely necessary; and from the fact that cable traction companies will put in cable systems where the track construction alone costs very nearly $100,000 per mile, single track, as in New York, I think we can afford to spend quite a little on a conduit system which will operate quite as well as the cable system and certainly has advantages which the cable has not. The problem is, primarily, one of mechanical construction of the conduit. We must get a large conduit, a dry conduit; we must place the wires in such positions as to make them high and dry, and various other conditions must be studied. It seems to me that it is rather a rebuke to electrical engineers that they have not been able to devise, or have not devised such, or that some philanthropic men or corporation have not come along and advanced the interest of the conduit system; but they have not. Let us take the cable conduit, for instance (and those that have recently been built are certainly excellent conduits), and what do we want to do? If we look at the problem thoroughly, we want in the first place, as previously stated, to put the wire high and dry and protect it; the insulators must be far apart and located in manholes or pits; the contact should be an underbearing one; the voltage should be as low as the first cost of the plant will permit—in fact below 300 volts if possible, for reasons which I will bring out hereafter, and if possible we should use at a low voltage the structure as a return. I believe that those points can be met and that a system containing them can very readily be devised; in fact, Mr. C. H. Warner, an electrical engineer, of New York, and myself some time ago attempted to attack that problem. We were striving for the $50,000 and we have not as yet gotten it.

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*Abstract of a lecture delivered before the New York Electrical Society, November 1.

Now the main electrical point in the system is the voltage. If we can get the voltage low enough, why we may put the conductor on the surface of the street, as Mr. Edison proposed some time ago. There are various methods for utilizing low voltage, and one of them is that which has been adopted by the General Electric Company recently to supply the ordinary overhead trolley system; it consists in applying the three-wire system to the electric railroad, and it can be very readily applied to conduit construction in this way. We can take an ordinary conduit, such as the Broadway conduit, and let the structure itself be the neutral wire. Suppose we use about 300 volts; now we put, as you know, in many conduit systems two wires, an outgoing and a return wire. In the three-wire system we use two wires also, no more. One forms a negative, the other a positive, and the structure neutral, and by alternately connecting between the neutral and one side and the neutral and the other side we can balance up our three-wire system fairly well without very much additional trouble, because although one car may be stopping, another may be going at full speed and another up grade, still for all that we can get a fairly even distribution and fairly even balance. But other devices could be found for balancing the system. We can also have a double track system with one set of three wires. For instance, the plus wire in one conduit of one track and the minus wire in the other, the structure being the neutral. In that way we could really have the voltage about 250 for actual work, while we would have 500 volts for distribution. If the Edison Illuminating Company can afford to spend millions in installing underground three-wire feeders at 220 volts for furnishing hundreds of horse-power in lights, it certainly seems possible that electric railway companies, whose dividends are just as high if not higher, could afford to put in a system at the same or perhaps somewhat higher voltage, and perhaps in that way something successful may be done.

The point is simply this: I do not think it is so much a question of building a system, but it is one which sounds very like this, What will it cost? The cost appears to me to be necessarily so great as to preclude the adoption of the conduit in any but our largest cities; but if we can build a system even at high cost I feel quite confident that it is wanted. I am sustained in this opinion by many eminent electrical engineers and by the fact that a number of companies are willing to risk their good dollars in putting down such a system. The cost, I think, will not be less than $30,000 to $40,000 per mile, single track —that is including perhaps some cheap paving. This estimate, however, is low and not for the best construction and assumes that there will be but very little obstruction in the way of pipes, sewers, etc. But we must not compare this with the trolley. The trolley will reign supreme in its own field, and it certainly has been of enormous value in the ten short years of its life; and to say that at the coming of the conduit system the trolley will go out is to make a false prophecy. We will never get a conduit system which will be put in for $20,000 a mile, track and all, but I believe we have large cities in which we cannot have an overhead wire, where we can put in an open-slot conduit and operate it approximately at a cost such as I have given. I do not mean to say that some of the other systems won't work, because some of them do work experimentally; but I think absolute simplicity can only be gained by getting down our mechanism to the simplest forms and fewest parts, and arranging it so that it can always be gotten at and be readily and easily repaired.

(To be continued.)

The Chemical Theory of Accumulators[*]—VI.

BY E. J. WADE.

As regards the negative electrode, no difficulties stand in the way of assuming its direct conversion into sulphate; in fact, this appears to be the only action possible. It is well known that in strong solutions of acid it takes place by local action with a liberation of hydrogen, exactly in the same way as zinc is acted upon, and the tendency must exist, therefore, in weaker solutions. Doubtless, however, low oxides and hydrates will also be produced should the solution be abnormally weakened in correspondence with the modifications that take place at the positive electrode under these conditions.

So much, then, for the *a priori* arguments based on deductions from general chemical and electro-chemical principles, and which are all in favor of the double sulphating theory of discharge. How, now, is this conclusion supported by direct observation and experiment?

Owing to the difficult nature of the chemical analyses involved, extremely few reliable and systematic investigations are available. Those, to which frequent reference has already been made, of Messrs. Gladstone and Tribe and of Dr. Frankland in 1883, both proved that sulphate was formed in increasing quantities as the discharge proceeded, and was the only normal product at either electrode. Very few details are given as to the precise nature of the cells, but small pasted plates, specially prepared for the purpose, appear to have been employed. Seven years later Prof. Ayrton made public the results of some experiments performed under far more practical conditions, which fully confirmed the above conclusions. Cells of a well-known type (E. P. S. 7L, 1888, type) were used, and were charged and discharged at their normal working current. At various periods during these processes portions of the active material were abstracted from both electrodes and subjected to analysis by Mr. Robertson, while at the same time all changes in their color, degree of hardness, etc., were carefully noted. All the figures are given, however, in terms of the *percentage* composition of the paste, and, in no case, were any quantitative analyses made in the sense of determining the *total* quantity of sulphate formed or peroxide reduced, so it is impossible to institute any comparison with the amounts calculated from the ampere-hours obtained. The same result may be arrived at, however, by considering the amount of acid withdrawn from the electrolyte, as indicated by changes in its specific gravity; but the liquid must be kept uniform by stirring or other means, and even then the results will only be approximately correct, as the acid in the plates will never be quite the same strength as that surrounding them, unless they are exceptionally thin. Such observations have been made by Frankland, Schenck and Farbaky, Kohlrausch and Heim, Ayrton and many others, some of which agree fairly well with the hypothesis of the formation of normal sulphate, while others show considerable discrepancies, and have been used to support arguments in favor of basic sulphates; but it is more probable that they are really due to experimental errors from the cause given above.

The real arguments in favor of the formation of basic sulphate lie in quite another direction. The difficulty of forming a perfectly satisfactory physical conception of the way in which large quantities of lead sulphate can be alternately produced and broken up during the processes of discharge and charge was referred to in the second article of this series, and the direction in which an explanation must be sought suggested; but it is now time to examine into the question a little more fully.

In the first place it must be borne in mind that the active material in all electrodes, whether of the Faure, Planté, or any other type, is obtained by its reduction, either chemically or electro-chemically, from other compounds more bulky than itself, and exists in a state of molecular sub-division far finer than could be produced by any mechanical means. The electrolyte may be considered, therefore, as having a more or less free access to almost every individual molecule of which it is composed, and at the commencement of discharge the formation of sulphate will take place more or less uniformly throughout the whole mass. Now, one of the most frequently observed facts with regard to lead storage cells has been the large percentage of material that remains unacted upon at both electrodes at the end of a discharge. In some early experiments of Mr. Swinburne's he found this to be over 90 per cent., and the proportion differs probably with every different type of cell, but 50 per cent. appears to be the maximum proportion that is ever converted into sulphate during a normal discharge, even under the most favorable conditions; that is to say, every molecule of sulphate at both the positive and negative electrodes has left as a backing a molecule of peroxide and metallic lead respectively; and, on recharging, the current is by their means distributed to every portion of the electrode. The sulphate, being so intimately mixed with the unreduced material, cannot impart to it its characteristic white color, but only causes the electrodes to assume a lighter tint. If, however—owing to over-discharging or to local action while at rest, especially when partially discharged —still more sulphate is formed, it must necessarily begin to aggregate into masses which will be more distinctly visible and more difficult to reduce in proportion as their size increases, because the conductive backing is destroyed and the current has no means of reaching them, and hence the formation of that irreducible "white sulphate" so disagreeable to all who have had practical experience of lead storage cells.

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[*] From *The Electrician*, London.

This appears to be the most probable explanation of the physical behavior of the cells, if only the normal lead sulphate $PbSO^4$ is assumed to be produced; but it can be made more complete and satisfactory if the formation of other sulphates is allowed to be possible.

In this case, considering the positive electrode first, every molecule of normal sulphate formed may be supposed to further enter into combination with a molecule of unreduced peroxide to form the basic sulphate $PbSO^4, PbO^2$. The combination is in all probability an extremely feeble one, just a stage beyond the most intimate mixture; but it will, no doubt, endow the sulphate with a certain degree of electrical conductivity, and render its subsequent reduction far more feasible, while the resultant color will also be something between that of its two component parts. According to this theory "sulphating," commonly so called, now consists in the breaking up of each molecule of the basic sulphate to form two molecules of normal sulphate,

$$\left.\begin{matrix} PbSO^4 \\ PbO^2 \end{matrix}\right\} + H^2 + H^2SO^4 = 2PbSO^4 + 2H^2O,$$

and takes place when the supply of uncombined peroxide runs short, the action being made evident by the appearance of the non-conducting white compound.

This theory is substantially that advanced by Dr. Frankland, who believes he has isolated such basic sulphates; but they break up so easily into mere mixtures that no positive proof of their presence in cells has ever been obtained, while many think they do not exist. Indirectly, however, a good many facts seem to lend support to the possibility of some such compound being formed at the positive electrode.

In the first place all lead salts enter into basic combinations with the greatest ease, a fact which Mendeléeff has emphasized in his well-known treatise on chemistry.

Secondly, it is extremely significant that a positive electrode should be practically exhausted when at most only 50 per cent. of its peroxide is converted into normal sulphate, for this is just the percentage corresponding to the conversion of the *whole* of the peroxide into *basic* sulphate. Up to this point the discharge process will have been greatly facilitated, and have proceeded pretty easily owing to the whole mass remaining more or less conductive; but now a formation of normal non conductive sulphate sets in which rapidly covers all the free surfaces with an insulating film and almost entirely stops any further action. An analysis made by Mr. Robinson of some sediment that fell from some positive plates discharged down to a potential difference of 1·6 volts in one of Prof. Ayrton's experiments gave a composition almost identical with $PbO^2, PbSO^4$; and in the course of some other analyses he observed that the residues left after dissolving out the peroxide with nitric acid, although presumably pure normal sulphate, were a brownish yellow color, and only became white after boiling with the acid, which is very suggestive of basic salts.

(*To be continued.*)

They Follow "Electricity's" Advice.

The young men of the Edison Electric Light Company of Philadelphia have organized an electrical club for the discussion of electrical and scientific questions. E. M. Stack is president, A. T. Mayers vice-president, and C. J. Duns secretary.

ELECTRIC TRACTION IN ENGLAND.

(From our London Correspondent.)

During the past few years the question of electric traction has occupied the attention of the Board of Trade a great deal. Not long ago a joint committee of the Lords and Commons held protracted sittings to consider the effects of electricity, used for traction purposes, upon railway signals, telephone lines, etc. The evidence elicited at these sittings was given in your columns at the time, and the result of the conference was the drawing up of certain important rules to which we have already referred.

The Board of Trade is now expressing its desire to grant any further powers and facilities which may tend to encourage the erection of light railways, also electric and steam tramroads.

The present requirements imposed by the Board are alleged in some quarters to stand in the way of the erection of small lines, and this has led Sir Courtney Boyle, C. B., on behalf of the Board of Trade, to address a communication to each of the following public bodies requesting the appointment of a small deputation from each to attend a conference to be held at the Board of Trade on an early day with the object of discussing, (1) How far the usual requirements of the Board of Trade as to constructing and working new railways may fairly be relaxed, especially in case of lines built through sparsely populated and agricultural districts. (2) Whether additional legal facilities for obtaining powers to construct tramroads and light railways are necessary or desirable: The Associated Chambers of Commerce, the Central and Associated Chambers of Agriculture, the London Chamber of Commerce, the Railway Companies' Association, Institution of Civil Engineers, London County Council, Association of Municipal Corporations, Association of County Councils.

The application of electricity to ordinary road vehicles is also hindered in a measure by the locomotive acts at present in force. A few months ago London streets were all excitement through the plying along among the other vehicles of an electric wagon. The question was brought before the Chief Commissioner of Police as to whether it was legal to drive such vehicles through the public thoroughfares. The Commissioner in reply stated that an electrically propelled vehicle must come under the Locomotive acts in the same way as steam vehicles. It is now considered that special Parliamentary acts will have to be passed ere electric vehicles will be placed on a similar footing to horse traction.

Public Installations in England.

Within the past few months there have been quite a number of electric lighting installations inaugurated, the usual festivities and ceremony accompanying each inauguration. Among those which have already been started are Hampstead, Worcester, Ealing, Portsmouth and Burton-on-Trent. On October 31 the Bolton ceremony took place and on November 9 Southport station was started. There are several others to be completed within the next few weeks, including Halifax, Cardiff and Stafford. The central station "dinner-man" is having a good time just now in England satisfying his epicurean tastes.

Historic Mansion Lighted from Oil Engines

Houghton Hall in Norfolk, the historical seat of the Walpole family, has recently been extensively lighted by electricity for the present occupant, Viscount Grey de Wilton. Over 500 16 c. p. incandescent lamps are used for the Hall, arc lamps being used for lighting the yards. The outstanding portion of the mansion has been altered to contain two complete sets of generating plant, consisting of two 16 h. p. oil engines, two shunt wound dynamos and two sets of accumulators.

CORRESPONDENCE.

THE FRAUDULENT METHODS OF THE NATIONAL SCHOOL.

"Electricity's" Statements Confirmed.

[The following extracts from a personal letter received from one of the learned gentlemen whose names are being used without warrant by the National School of Electricity, Messrs. J. P. Barrett and J. A. Hornsby promoters, is interesting. The statements are simply added confirmation that Electricity's views are, as usual, correct]:

Mr. B. E. Greene.

Dear Sir: I have for some time past felt like writing to you concerning this institution, for you have, in Electricity, certainly more clearly and correctly stated the standing of this school than has anyone else.

In a few of your most cutting editorial remarks concerning the National School, Hornsby, et al., you told nothing but what we believe to be the exact truth. It has caused me some pain to feel that I stand before the country at large in a measure committed to this National School, and I should like to tell you exactly how this came about. . . . Hornsby came to me and presented his philanthropic sophistries, which I felt that I clearly saw through at the time, but in order to place myself right in the eyes of the engineering community I told him that I did not wish to *oppose* any move of real advantage and that I was willing to await developments. Meantime, I forbade the use of my name. . . . However, subsequently I noticed in a number of electrical papers that my name was being used in indorsement of the work of the National School. I wish to emphatically state that this was false and done without a show of authority from me. Had it not been for the connection of Profs. Carhart and Jackson with this scheme, I would have come out very plainly and severely on the whole matter long before this.

I would like to give you a few points obtained from recent letters from my Chicago friends in connection with the School as it really exists in that city. Both Hornsby and Barrett you know perfectly well, and I do not need to tell you anything about them. The first few instructors they employed were men whose character for veracity and morality was far below par. Their principal business manager is a young man utterly devoid of principle. I, unfortunately, know this to be true. . . . How an educational enterprise which has associated with it so many men of not only questionable but bad reputation can succeed is far beyond my comprehension.

I cannot but believe that the object of the School is a good one, but the immediate personnel of the men who are to carry it out certainly must cause the enterprise to fail. I confess that I do not understand how some of the men connected with the Electrical School have been persuaded to permit their names to be used in connection with its present management.

STORAGE BATTERY MATTERS.

To the Editor of Electricity.

Dear Sir: In reference to the decision of the United States Court of Appeals for Second District, in case of Accumulator Company versus Edison Electric Illuminating Company:

The day following the opinion of the Court upon the application of the counsel for the Edison Company the Court gave leave to file an application for a rehearing, to be submitted in printed form and accompanied with a printed argument in support thereof, and denied the motion of the counsel for the Accumulator Company for the mandate, holding that in abeyance until the decision was given upon the petition for a rehearing.

The decision in no way affects the business of the Electric Storage Battery Company, but applies solely to the New York Edison contract, and even if affirmed will only delay that work until May next, when the Swan patent expires.

Very truly yours,
The Electric Storage Battery Company,
W. W. Gibbs, President.

SOCIETY NEWS.

American Institute of Electrical Engineers.

The 91st meeting of the Institute will be held at 12 West 31st street, New York City, on Wednesday, November 21, at 8 P. M. A paper will be presented by Prof. George D. Shepardson, University of Minnesota, Minneapolis, entitled "Suggestions for an Index of Engineering Literature."

An opportunity will also be offered for the discussion of the paper, read by title at Philadelphia, by Mr. Charles P. Steinmetz, of Schenectady, and Dr. Frederick Bedell, of Ithaca, on "Reactance and Its Definition."

A meeting of Western members will be held on the same evening at Armour Institute, 33d street and Armour avenue, Chicago.

Applications have been received from the following candidates for associate membership and will be acted upon by Council at its meeting, December 19, 1894: Chas. A. Pratt, Chicago; Percival R. Moses, New York; Vance Lane, Omaha, Neb.; Louis Privat, Oak Park, Ill.; G. De Ryckere, Gand University, Belgium; Henry A. Lardner, State College, Pa.; Harry E. Dey, Brooklyn, N. Y.; Robert C. MacCulloch, New York; G. Hamilton Vanderslice, Pittsburg, Pa.; John O. Shedd, Marietta, O.; Geo. W. Graham, New York.

REMOVAL NOTICE.

The office of the American Institute of Electrical Engineers, which has been at 12 West 31st street since May, 1890, has been removed to rooms 1009 and 1010, Havemeyer Building, 26 Cortlandt street (tenth floor), New York City. The choice of the Havemeyer Building was due to its central location in the electrical district and its convenience to various lines of travel. The Institute meetings will be held at 12 West 31st street, as heretofore, until further notice. The office will be open from 9 A. M. to 5 P. M. It is equipped with a long-distance telephone and district messenger service. Over 100 electrical, mechanical and engineering periodicals will be found on file.

New York Electrical Society.

The 163d meeting of the New York Electrical Society will be held at Columbia College on Tuesday, November 27, at 8 P. M., when a most interesting lecture will be delivered on the subject of "Direct Current Motor and Dynamo Design" by Mr. Gano S. Dunn, electrical engineer of the Crocker-Wheeler Electric Company.

Among other points in this lecture special reference will be made to rating and its effect on design; the newest forces of winding, such as two circuits, double, etc., sparking and armature reaction. A method of making the increase of potential in a compound wound generator proportional to its load will be described, and many other hints and suggestions will be given of the utmost value to students and young electricians.

A successful test exhibition of a new device patented by the Audible Electric Block Signal Company was given recently on the Reading Railroad. As the "feelers" of the engine passed over the block plates the approach of a train more than two miles away, hidden by a curve in a deep cut, was indicated by the electric gong in the cab of the engine, and in about three and one half minutes the train came in sight. After it had passed, the presence of an open switch was indicated, also the fact of danger from an overhanging end of a car partly on a siding and from an iron wire laid across the tracks. As this device works automatically and sounds a gong by the ear of the engineer there is little chance of an accident arising from defective or impeded vision or inattention on the part of engineers or firemen. The cost of equipping a road is said to be about $200 per mile, and the expense of signal towers and switch tower men is saved.

LEGAL NOTES.

The Westinghouse-Stanley Controversy.

At the recent hearing in the suit of the Westinghouse Electrical and Mfg. Company vs. William Stanley for alleged infringement of patents on certain improvements in systems of distribution issued to Stanley and now held by plaintiffs, Mr. Stanley filed a plea in which he sets up that the patent was procured by fraud and is void. He alleges that the invention was fully described by one Kennedy previous to his application for a patent, and that the Stanley patent was procured by the plaintiffs in his (Stanley's) name, for their own benefit, and that they knew all the facts and that the patent was void. The plaintiffs claimed that even if this is true Stanley has no right to set up such a defence, when he stood by and saw them take out the patents in his own name.

Telephone Patent Suits.

The Western Electric Company has begun three suits against the Harrison International Telephone Company. One of the suits is based on the patent of Thomas A. Watson on a telephone call signal and also on polarized armatures for electric bells. The other two suits are based on the alleged infringement of patents owned by the complainant on hinges for telephone boxes and magneto-electric generators for telephone call signals.

In the suit brought at Philadelphia by the Cutter Electrical Manufacturing Company against Henry A. Cleverly, Frank Stevens and Samuel Welsh for alleged infringement of the plaintiffs' patented improvements in electrical switches, Judge Dallas, after hearing argument on the 12th inst., reserved his decision.

Commissioner Romaine has concluded the hearing in the certiorari brought by Robert Scheffelbauer against the township of Kearny, N. J. Scheffelbauer was the lowest bidder for the street lighting, but the town committee gave the contract to George F. Woolston. Scheffelbauer wants the United States Supreme Court to set aside the award. The Kearny authorities, in their testimony before Mr. Romaine, claimed that Scheffelbauer was ignored because his plant was not as satisfactory as Woolston's.

Judge William A. Woods, of the U. S. Circuit Court, has given a decision in favor of the Citizens' Street Railway Company of Indianapolis in the suit of that company against the Indianapolis City Street Railroad Company. The latter company had been granted a franchise by the common council for right of way through several of the city streets, in many instances through the streets upon which were the tracks of the other company. The question at law was the right of the common council of the city of Indianapolis to grant right of way and franchise to the Indianapolis City Railroad Company. Judge Woods decides that the plaintiff company is entitled to an injunction against the defendants to restrain them from interference with the plaintiffs' rights.

The W. C. T. Macallen Company of Portland, Me., has filed a complaint in equity in the U. S. District Court for Connecticut against the Johns-Pratt Company of Hartford, alleging an infringement upon an electric insulator.

The suit of John E. Ridall, for $100,000 damages against the Brush Electric Company, has been begun at Pittsburg.

The suit of the Denver Consolidated Electric Company against the Standard Underground Cable Company has been on trial at Pittsburg. Damages of $50,000 are claimed on account of the alleged failure of Standard cable to fulfil the specifications of plaintiff.

Is the Detroit City Plant to Start?

Mr. J. L. Hudson, of the Detroit Lighting Commission, states that the Western Electric dynamos, the contract for which has not yet been confirmed by the council, have been shipped from Chicago, and the plant will be put into running order at once.

Lecture by Prof. North.

Prof. Edward P. North, member of the American Society of Civil Engineers, will deliver a lecture before the engineering department students of Union College, Schenectady, on November 22. Gentlemen connected with the General Electric Company may obtain tickets on application to Prof. Olin H. Landreth, Union College. Prof. North's lecture will be on "The Relations Between Cheap Freight Rates and National Prosperity," a subject which he is well qualified to handle in an interesting manner, as he has but recently returned from the International Congress of Commerce in Holland, where he represented the United States. He is well known as the advocate for the deepening of the Erie Canal, the through line of railways from our country to South America, and the Nicaragua Canal, and is favorably known as a writer of editorials favoring the building of American ships by Americans.

Personal.

Among our out of town visitors last week were Messrs. A. C. Garrison, of the Columbia Lamp Company, St. Louis; Charles E. Gregory, of Chicago, and Charles Holmes, purchasing agent of the Chicago Edison Company.

Mr. W. T. Mottram has returned from a brief European trip and will locate in Texas as a general selling agent.

Mr. John Muir, some time of the Edison General and G. E. railway department, is now the Eastern traffic manager of the Pacific Mail Steamship Company.

Bids for a Wire Contract.

Bids have been opened by the Boston Fire Commissioners for wires for the underground service. The proposals were to furnish 7,000 feet No. 61 conductor cable, 2,500 feet No. 10 cable, 2,000 feet No. 37 cable and 900 feet overhead No. 37 cable. The bids were as follows:

	No. 61.	No. 37.	No. 10.
Eastern Electric Cable Co..........	$91.50	$55.50	$20.00
Safety Insulated W. & C. Co.......	89.50	55.50	22.50
Okonite Co., New York.............	117.00	75.00	27.00
Day's Kerite Co., New York........	99.40	66.55	22.75

Boston Notes.

The National School of Electricity, the faculty of which includes many of the best known electrical engineers in the country, but about the true nature of which as an educational and philanthropic institution there appears to be some doubt, has just opened a New England office in the new Carter Building, Washington street, Boston, which is to be in care of Mr. H. W. Pope.

The Boston Electric Light Company is seeking authority to issue $300,000 additional bonds for the purpose, among other things, of meeting the expense of placing its wires underground.

In view of the expiration of the Edison lamp patent on the 17th inst., some New England lamp makers are making ready to resume business, and are advertising remarkably low prices.

The electric railways of New England are doing a capital business, an increase in their earnings being reported every succeeding month. Of course patronage and construction alike are slow during winter, but everybody is feeling sanguine that with the approach of spring there will be a big boom in railroad enterprises.

There is not an electric man throughout New England who will not be filled with regret when he hears of the sad death of Mr. S. G. Stiners, manager of the Pawtucket, R. I., Gas and Electric Light Works, who was killed by a train a few days ago.

The Bell Telephone Company has determined to accept the inevitable in the matter of disposing of its new issue of stock. The authority granted that company by the Massachusetts State Legislature to increase its capital by $30,000,000 was conditional on the stock being sold by auction. This condition is to be complied with, and the headquarters of this $50,000,000 corporation will remain as heretofore at Boston.

General News.

What is Going on in the Electrical World.

Eaton Rapids, Mich.—At the recent election the city voted in favor of owning and controlling an electric light plant.

Ionia, Mich.—The managers of the House of Correction have applied for a grant of $30,000 to put in an electric lighting plant.

Vancouver, B. C.—The electric street railway and lighting system of this city have been sold to an English company for $350,000.

New Haven, Conn.—Plans have been submitted to the park commissioners for laying an electric road to the summit of East Rock.

Portland, Me.—The machinery in the electric light station here was badly damaged by water at the recent fire in the Armory building.

Saratoga, N. Y.—L. B. Gleason, of New York, has taken charge as receiver of the Saratoga Gas and Electric Light Company's plant and finances.

McKeesport, Pa.—Electrician Henry Morgan has resigned his position with the Altmeyer Light Company to take charge of the Coppenheimer light plant.

Flemington, N. J.—At a meeting held here to obtain the opinion of the citizens regarding the lighting of the streets by electricity, the question was put to a vote and unanimously adopted.

Little Rock, Ark.—The Van Buren and Fort Smith Electric Railroad Company have filed a mortgage in favor of Geo. C. Gronely for $150,000, the money to be used in constructing their road.

Niagara Falls, N. Y.—The proposed gorge electric railroad to Lewiston is commending itself more and more to the people as they reflect on the advantages of the scheme; it will probably be built.

New Brunswick, N. J.—Mayor Van Cleft has signed the electric railway ordinance, which gives the City Railway the authority to extend their road and change it from a horse to a trolley railway.

Kansas City, Mo.—The North East Street Railway Company's car house and equipment were destroyed by fire on the 6th. Thirteen electric cars were burned, and the total loss was about $20,000.

DeLand, Fla.—John B. Stetson, of Philadelphia, is making arrangements for the formation of a corporation with a capital stock of $300,000, to establish and operate at this place an electric road, an ice plant and an electric light plant.

Atchison, Kan.—The merchants of Atchison are getting up a celebration in honor of the completion of the Atchison electric street railway Six miles will be in operation December 1, but the celebration will not take place until the 11th.

Middletown, O.—The Middletown Electric Light and Power Company, which had obtained a contract for lighting the city for ten years, was voted a franchise to establish an electric plant at the recent election. Work on the new plant will begin at once.

Kalamazoo, Mich.—The proposition to issue $40,000 bonds to build an electric light plant was voted on at the recent election and carried by a large majority, but claims of an illegal election are made, and the council is likely to be enjoined again before it makes a contract.

Hamilton, O.—The council has awarded the contract for the electrical apparatus of the new electric light station to the Western Electric Company of Chicago, who were the lowest bidders and who received the recommendation of the special electric light committee.

New Orleans.—The stockholders of the Orleans Street Railroad have decided to change the motive power of their line to electricity and to do it as soon as possible. The president of the road says that the tracks, roadbed and all the equipments will be of the best character.

Lancaster, Pa.—It is announced that P. B. Shaw has purchased a majority of the stock of the Edison Company of its competitor, the Citizens' Electric Company, and of the Lancaster Gas Light and Fuel Company, and that the three companies would be consolidated into one corporation, with a capital stock of $650,000.

Montreal, Can.—Negotiations are in progress between the Royal Electric Company and the Stanley Electric Company of Pittsfield, Mass., for the use of all the latter's patents and models controlled by it. Should the negotiations be completed, new workshops will be erected here and other changes inaugurated.

Brooklyn, N. Y.—The Municipal Electric Light Company has applied to the common council for a franchise to establish and maintain a system or systems for lighting by electricity and to apply electricity for heat and power throughout all the wards of the city of Brooklyn not included in the franchise now held by the company.

Terre Haute, Ind.—The city council having granted the contract for lighting the city to the Citizens' Electric Light and Power Company, which has now in operation an electric street railway here, its competitor for the contract, the Terre Haute Electric Company, has applied to the council for a franchise to construct and operate a street railroad.

Hamilton, Can.—Application has been made by Messrs. Beggs and Lewis, of Toronto, for the incorporation of the Toronto, Hamilton and Niagara Falls Electric Railway. The company asks power to construct an electric railway from Toronto to Hamilton, and thence to a point on the Niagara River, with a branch from Grimsby to Smithville and Dunnville.

Warren, O.—A. A. Anderson and John McVey, of Youngstown, have made application to the county commissioners for a franchise providing for the construction of an electric railway from Youngstown to Niles, ten miles. They agree, if a franchise is given them, to have a line in operation within a year. Cleveland, Warren and Niles capitalists are also interested in the project.

Lynchburg, Va.—The Lynchburg Telephone Company, which has been organized to establish a new telephone system here, has elected the following officers: President, W. P. Roberts; vice president, Edgar Franklin; secretary and treasurer, Walker Pettyjohn; directors, the above-named officers, with James Hancock, C. W. Scott, R. J. Snead, W. L. Pierce and H. P. Woodson.

Pittsburg, Pa.—The Westinghouse Company's latest shipments to the Cataract Construction Company, Niagara Falls, were made last week. They are now finishing a third dynamo of 5,000 horse power, which ends the contract. The Construction Company expect to turn on their power December 15. A large number of plants for various manufacturing purposes are ready to take power on that date.

Williamsport, Pa.—The Lycoming Improvement Company has taken formal charge of the Vallamont Traction Company's system and has now under its direct management the Williamsport Passenger Railway, the Wycoming Electric Company, the East End Passenger Railway and the Vallamont Traction Company. The South Side Railway will also be turned over to the same management after it has been opened for travel.

Staten Island, N. Y.—The bondholders of the Richmond (S. I.) Light, Heat and Power Company have received an offer at the rate of 60 cents in cash on the par of their holdings. It is said to come from Gen. Thomas and his associates, who have recently become interested in the Staten Island Ferry, and is believed to indicate a movement for electrical development of considerable significance to Staten Island.

Newark, N. J.—The Consolidated Traction Company intends to appeal from the decision of the Supreme Court declaring invalid the ordinance by which the old board of works gave the company important franchises in July, 1893. Despite the protests of many citizens and over the veto of Mayor Haynes, the board gave the company permission to construct lines and run its cars in a number of the city streets where they were objectionable. Under the decision the franchises revert to the city.

Detroit, Mich.—Albert Johnson, of New York, a brother of Congressman Tom Johnson, of Cleveland, in an interview with Mayor Pingree concerning the consolidation of our street railroads and extension of the lines said: "Aside from 100 miles of road on the Nassau line in Brooklyn, of which thirty-five miles are completed, and thirty miles of road in Yonkers which I am building, I own seven lines in Pennsylvania. There, together with others, I control a number of lines which connect sixteen towns within a radius of eight miles from Allentown by electric cars, and you can go from one place to another for five cents. About midway between Allentown and Bethlehem, I have a park, stocked with all kinds of animals, a menagerie for winter, a theater in which daily performances are given during the summer. There is a grand stand for 5,000 people, and all the admission charged to all is ten cents to the grand stand reserved seats. These dimes pay for all the expenses. People from these sixteen towns visit the place daily, and on Sundays the crowds are such that hundreds have to be refused admittance to the shows."

The C. & C. Electric Company.

Mr. F. Houghton, Cleveland, manager for the C. & C. Electric Company of New York, has closed a contract with Parke Davis & Company, Detroit, for an electric light and power plant, which will supply the light and power for their extensive buildings bounded by Joseph Campau and McDougall avenues, Guion and Atwater streets, and will also furnish a large amount of electric lighting in the neighborhood. The work of construction has already been commenced and will be pushed rapidly to completion.

The Metropolitan Electric Company.

The Metropolitan Electric Co., Nos. 186 and 188 Fifth avenue, Chicago, have made arrangements with the patentee to handle the Allen Soldering Stick, and have a large stock on hand, and will be able to sell to the dealer or consumer at satisfactory prices. This little article is well known to the trade and occupies its niche in the gallery of specialties of the Metropolitan Company.

Hill Switches in Chicago.

The Central Electric Company has contracted for the General Western Agency for the well-known line of switches manufactured by the W. S. Hill Company. The Central Electric Company will carry a large and complete line of these goods in their Chicago warerooms. This affords many advantages to customers in territory tributary to Chicago. The saving in freight and express charges will amount to an item of no little importance to buyers. Another article that is receiving considerable attention is the Kinsman desk lamp. Everyone who has used this admirable desk fixture gives it unqualified approval. The Central Electric Company also controls the sale of these in the West.

Frink's Reflecting Fixtures.

Mr. I. P. Frink, the pioneer in the building of scientific reflectors for lighting large interiors, has issued a handsome catalogue illustrating the innumerable styles of reflectors for gas, oil and electric lighting purposes.

The pocketbook of the most humble can be satisfied in Mr. Frink's stock, as also the tastes of the most luxurious. The catalogue contains almost everything worth mentioning in the reflector line, and will be sent to any inquirer. A list of several hundred well-pleased purchasers is included. Mr. Frink's address is 551 Pearl street, New York.

Uses of Compressed Air.

The Clayton Air Compressor Works, Havemeyer Building, New York, have issued a pamphlet on the "Uses of Compressed Air." This list cites about seventy different applications of air under pressure, and is a most convincing commentary upon modern advancement in engineering, manufacturing and industrial lines.

It is of especial interest to engineers, railroad men, machine and construction shops, granite and marble works, chemical works, sugar refiners, rubber and silk mills, tin ware, pipe and hose manufacturers; and to all industries who use artesian wells, automatic sprinklers for fire protection, oil for fuel; and to physicians, hospitals or baths, who use sprays for curative purposes. The list is mailed free on application.

The Belknap Motor Company.

At the recent stockholders' meeting of the Belknap Motor Company at Portland, Me., the regular 6 per cent. dividend was declared, payable December 15. A large number of orders now on hand, amounting to about $12,000, places the company in a most favorable position for the beginning of the new year.

Removal Notice.

The office of the New England Agency of the Westinghouse Electric and Manufacturing Company, formerly located at 620 Atlantic avenue, Boston, Mass., has been removed to Exchange Building, 53 State street, Boston.

Columbia Lamps in New York.

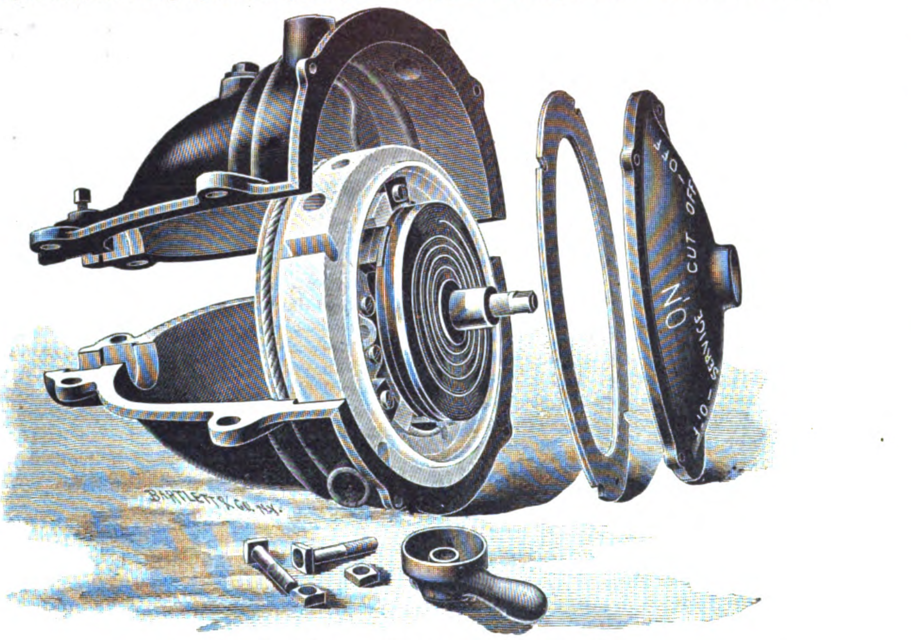
The Columbia Lamp Company of St. Louis have opened offices in the Havemeyer Building, and will hereafter carry a large stock of lamps to supply all customers at short notice. Mr. Charles I. Hills will continue to hustle in the company's interest in this section.

Johnson-Van Vleck Service End Cut-Out.

We illustrate below the improved Service and Cut-out of the Interior Conduit and Insulation Company, which is being generally called for in architects' specifications as well as required by underwriter associations. It is placed at the inlet of the three-wire system to buildings and is the point at which all the circuits for light and power are controlled. In case of fire the cut-out is accessible to firemen. Its advantages over a triple breakdown switch are apparent, as it is thoroughly waterproof. The switch is almost always placed in a location where there is more or less dampness.

The application and method of installing the cut-out are generally evident on inspection. The piece of pipe enclosing three conductors embedded in insulating material is a standard article of manufacture, as are the flexible conductors used within the iron case.

In installing, first attach the flexible conductors to the terminals projecting from the conduit—take the porcelain base out of the cast-iron case, remove the switch spring disk and connect up, using proper fuses, and carefully solder conduit terminals to flexible connector. Pack the porcelain base with any convenient packing—the company recommend sisal rope, and furnish it with the cut-out. Put the two halves of the iron case together with their flange bolts, remove the plug at top of the case and fill in with insulating compound. Connect the risers through the three outlets provided for that purpose, and pack the outlets as they pass through the iron case to insure a tight joint.



Johnson-Van Vleck Service End Cut-Out.

The Service End Cut-out was devised by Mr. E. H. Johnson, president of the Interior Conduit and Insulation Company, in conjunction with Mr. J. H. Van Vleck, electrician of the Edison Illuminating Company of New York.

INCORPORATIONS.

The Boston and Sequim Coal Company, Port Townsend, Wash.—to mine and develop coal, ores and other minerals; own and operate railroad and electric plants, etc. Capital stock, $50.000. Promoters: Wm. B. Dennis; Wm. A. Halteman, N. C. Strong, H. H. Boyce, D. C. Heath, A. B. Poland, Graham B. Dennis.

The Atlantic and Pacific Improvement Company, Tacoma, Wash.—to buy and sell personal property and real estate; build and operate steam and electric railways, saw mills, brickyards, etc. Capital stock, $500,000. Promoters: Chas. B. Mortice, John R. Mortice.

The Kidder Elevator Interlock Company (incorporated in W. Va.), New York, N. Y.—to manufacture, erect and sell mechanical, electrical, or other appliances for use upon passenger, freight and other elevators, etc. Capital stock, $300,000. Promoters: T. P. Kidder, Boston, Mass.; Clement B. Smith, Wilmington, Del.; H. S. Stallknecht, New York City.

The Archer and Pancoast Company, New York City—to manufacture lamps, electroliers and gas fixtures. Capital stock, $100,000. Directors: Archer V. Pancoast, Charles A. Cheever, Byron Traver, William S. Fearing, John B. Summerfield and Samuel B. Lawrence, of New York City; Henry T. Bragg, of Yonkers; Gurdon S. Howe, of Rosebank, Staten Island, and Edward Cornell, of Central Valley. Samuel B. Lawrence subscribes for $99,600 of the capital stock.

The Boynton Transit Company, of France (incorporated in W. Va.), New York. N. Y.—to acquire patents and patent rights for appliances, etc., relating to steam and electric railways, etc., in France. Capital stock, $5,000,000. Promoters: J. E. De Navarro, Wm. H. Boynton, New York City; Eben Moody Boynton, Newbury, Mass.

The Boynton Transit Company of Spain (incorporated in W. Va.), New York, N. Y.—to acquire patents for appliances relating to steam and electrical railways, etc. Capital stock, $5,000,000. Promoters: J. F. De Navarro, Wm. H. Boynton, New York City; Eben Moody Boynton, Newbury, Mass.

The Century Telephone Company (incorporated in W. Va.), New York, N. Y.—to manufacture and use all kinds of electrical machines, machinery, etc.; construct, equip and operate telegraph and telephone lines, etc. Capital stock, $250,000. Promoters: Henry O. Reed, E. F. Birdsall, New York City; G. H. Morton, Dobbs Ferry, N.Y

The New England Public Works Company has been organized at New Haven, Conn., with a capital stock of $25,000, to take contracts and to operate waterworks, electric light plants, etc. Subscribers to the stock: Edward H. Phipps and Wm. S. Pardee, New Haven; Charles H. Egler, Flushing, N. Y.; Loring N. Farnum, Boston.

A charter has been issued by the State Department at Harrisburg, Pa., to the Philadelphia and Lansdale Railway Company to build a line from Philadelphia to Lansdale, sixteen miles. The capital is $100,000, and the president Robert A. Welch of Philadelphia.

The Electrical Maintenance Company (incorporated in W. Va.), New York, N. Y.—to contract with owners of dynamos, electrical plants, etc., to keep the same in good repair, etc. Capital stock, $250,000. Promoters: Jno. Dau, Freman D. Bewley, R. L. Johnson, New York City.

The Morristown and Perkiomen Creek Electric Railway Company, Philadelphia, Pa.—to conduct, maintain and operate an electric railway. Capital stock, $50,000. Promoters: Paul W. Smith, Harry E. Parsons, Jas. J. Rehan, of Philadelphia.

The Mt. Jewett Electric Light and Power Company, Mt. Jewett, Pa.—to supply light and power by means of electricity to the public in the borough of Mt. Jewett. Capital stock, $2.000. Promoters: Murton J. Gallup, Arthur G. Phillips, Calvin T. Stahl, of Mt. Jewett.

The Muncie Electrical Works, Muncie, Ind.—to manufacture, produce and sell electrical and steam machinery. Capital stock, $25,000. Promoters: Webster S. Richey, Albert S. Richey, Richard F. Platt.

The Florence Power and Water Company, Florence, Col.—to furnish steam and electric power for mills, manufacturing, etc., in Florence. Capital stock, $100,000. Promoters: W. E. Johnson, W. K. Johnson, H. A. Sumner, all of Florence.

The Jasper County Electric Railroad Company, Carthage, Mo.—to construct a railroad. Capital stock, $150,000. Promoters: J. W. Halliburton, E. W. Fitch, Isaac Perkins, all of Carthage.

The Cambridge Electric Light and Power Company, Cambridge, Ill.—to erect an electric lighting plant for the purpose of furnishing lights for lighting streets, commercial houses, etc. Capital stock, $12,000. Promoters: D. D. Lamb, Henry White, C. M. Turner, E. D. Richardson, F. O. Dahlberg.

The Mechanicsburg and Boiling Springs Electric Railway Company, Harrisburg, Pa.—to construct, maintain and operate an electric railway. Capital stock, $100,000. Promoters: Jno. B. Skyles, Martinsburg, Pa.; S. Ritter Ickes, W. K. Meyers, Harrisburg, Pa.

A certificate has been filed at Chicago of a change of the name of the United States Amusement Company to the United States Electric Advertising Company.

The Madison Electric Light and Power Company, Madison, Neb.—to own and construct an electric light and power plant in the city of Madison. Capital stock, $10,000. Promoters: Wm. V. Allen, Peter Rubendall, Frank M. Prince.

ELECTRICAL PATENT RECORD.

Letters Patent Issued November 6, 1894.

ELECTRIC RAILROADS AND APPLIANCES.

528,561. Trolley-Wire Clip. James W. Perry, Philadelphia, Pa., assignor to the Johns-Pratt Company, Hartford, Conn. Filed May 5, 1894.

528,685. Trolley-Catcher. Albert S. Osborn, Rochester, N. Y. Filed May 9, 1894.

528,767. Trolley-Line Breaker. Charles H. Dey and John M. Anderson, Boston, Mass. Filed Feb. 16, 1894.

528,788. Bond for Electric Railways. Henry B. Nichols and Frederick H. Lincoln, Philadelphia, Pa. Filed Sept. 20, 1894.

ELECTRIC LIGHTS AND APPLIANCES.

528,642. Electric-Arc Lamp. Alfred H. Moses, Jr., New York, N. Y. Filed Jan. 8, 1894.

528,684. Electric-Arc Lamp. Charles F. Ongley, New York, N. Y., assignor to George J. Schoeffel, same place. Filed Feb. 17, 1894.

DYNAMOS, MOTORS, ETC.

528,608. Utilizing Electric Motors for Operating Machinery. Ernst Richter, Berlin, Germany, assignor to Siemens & Halske, same place. Filed May 31, 1893.

BATTERIES.

528,6,7. Storage-Battery. Charles J. Reed, Philadelphia, Pa., assignor to the Reed Electric Company, same place. Filed June 5, 1894.

528,648. Storage-Battery. Charles J. Reed, Philadelphia, Pa., assignor to the Reed Electric Company, same place. Filed June 8, 1894.

528,669. Galvanic Battery. Mortimer M. Hayden, New York, N. Y. Filed Feb. 21, 1894.

528,740. Secondary Battery. Elias M. Poston, Springfield, Ohio. Filed Jan. 29, 1894.

TELEPHONE AND TELEGRAPH APPARATUS.

528,566. Combined Municipal Telegraph and Telephone System. Harry M. Seitzinger, Wilkesbarre, Pa. Filed May 28, 1894.

528,590. Telephone-Exchange System. Wallace Childs, Fort Smith, Ark. Original application filed May 27, 1890. Divided and this application filed May 12, 1891.

528,591. Telegraphic and Telephonic Exchange System. Wallace Childs, Fort Smith, Ark. Filed May 27, 1890. Renewed April 21, 1894.

528,592. Telephony. Frank R. Colvin, New York, N. Y. Filed July 26, 1894.

558,640. Telephone. William C. Lockwood and John M. Lockwood, Brooklyn, N. Y. Filed June 14, 1894.

528,902. Means for Multiplex Telegraphing Between Cars of Railways. Aaron Fryer, Bath-on-the-Hudson, N. Y., assignor of one-half to David Wiggins, same place. Filed March 17, 1892.

MISCELLANEOUS.

528,529. Plug for Establishing Electrical Connections. Charles W. Brown, Montreal, Canada, assignor to the Bell Telephone Company of Canada, Limited, same place. Filed Jan. 16, 1894.

528,539 Rheostat. John C. Fyfe, Chicago, Ill., assignor of one-half to James Hayes, same place. Filed April 27, 1894.

528,547. Electrically-Operated Elevator. Elias Marshall, Boston, Mass. Filed Jan. 20, 1894.

528,564. Electrical Retoucher Charles M. Savage, Warren, Pa. Filed March 17, 1894.

528,586. Apparatus for Electrodeposition, Henry L. Bridgman, Blue Island, Ill. Filed Oct. 3, 1893.

528,587. Apparatus for Electrodeposition. Henry L. Bridgman, Blue Island, Ill. Filed Oct. 3, 1893.

528,589. Electric Burglar-Alarm. Wilmot A. Brownell, Boston, Mass., and James B. Seager, Hancock, Mich. Filed Jan. 31, 1894.

528,593. Railway Signaling System. Murray Corrington, New York, N. Y. Filed Dec. 3, 1891. Renewed July 14, 1894.

528,620. Electric Hoisting Machinery. Alton J. Shaw, Muskegon, Mich., assignor to the Shaw Electric Crane Company, same place. Filed June 25, 1894.

528,635. Magnet. Adrian H. Hoyt, Penacook, N. H., assignor to the Whitney Electrical Instrument Company, Saco, Me. Filed March 14, 1894.

528,661. Process of and Apparatus for Forming and Treating Metals. Godfrey Engel, South Baltimore, Md. Filed Nov. 13, 1893.

528,678. Electric Alarm Clock. Michael McDonnell, New Bedford, Mass. Filed May 29, 1894.

528,744. Insulating Compound. Oscar Stiles, Omaha, Nebr. Filed March 26, 1894.

528,746. Speed-Stop for Engines. Benjamin F. Teal, Chicago., Ill., assignor to the Standard Valve Company, same place. Filed March 9, 1894.

528,778. Electrical Transformer. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company, of Connecticut. Filed April 6, 1894.

528,867. Automatic Railway-Switch. Charles F. Duval, Boston, Mass. Filed Nov. 25, 1893.

528,870. Apparatus for Measuring Electricity. William Friese-Greene, London, England, assignor of one-half to Charles Brawn, same place. Filed March 28, 1894.

528,881. Electric Leak-Alarm. Charles C. Kahne, Andrew A. Adkins, Winfield S. Peirce, John E. Martin and Geo. F. Kahne, Ashland, Ky. Filed July 6, 1894.

528,893. Rheostat. Alton J. Shaw, Muskegon. Mich. Filed April 10, 1894.

528,894. Rheostat. Alton J. Shaw, Muskegon, Mich. Filed April 10, 1894.

528,898. Railway Electric Switch. Walter V. Ash and Joseph H. Ash, Newark, N. J., assignors of one-half to the Art Automatic Electric Switch Company, of New Jersey. Filed July 5, 1894.

528,907. Rheostat and Heater. Robert C. Mitchell, New York, assignor of one-half to Henry W. Vail, Brooklyn, N. Y. Filed Jan. 17, 1894.

528,911. Coin-Operated Electric Apparatus. John H. Elfering, Cincinnati, Ohio. Filed Aug. 30, 1889. Renewed April 7, 1894.

ELECTRICITY.

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N. E. L. A.—The next annual meeting of the National Electric Light Association will be held at Cleveland, O., February 19-21, 1895. Every concern interested in either lighting or railway work should be represented in the membership of this body, and should have at least one representative at the Cleveland meeting. The Secretary is Mr. Geo. F. Porter, 136 Liberty street, New York.

EDITORIAL NOTES.

What's in a Name. Not many years ago a young man who had been employed for some time in the composing room of the New York *Tribune*, and whose services had been satisfactory to his employers, resigned his position voluntarily and requested of the foreman of the room a letter stating the simple fact of employment and faithful service. The foreman replied: "My name to a letter is worth money; when you find out what it is worth to you, let me know."

A few years afterward this young man was employed on the *Journal of Commerce*. When leaving that position, also voluntarily and after acceptable service, he requested of Mr. David M. Stone, the veteran editor, a similar letter. Mr. Stone replied:

"I have made it a rule of my life for fifty years never to sign a letter of recommendation for anyone under any circumstances. If anyone comes to me to ask about you I shall take pleasure in saying a good word for you; but for me to give anyone the use of my name publicly--*never*. My name has cost me fifty years of labor, *and it's all mine*."

Here we have two extreme examples of the manner in which men whose names have weight treated the question of loaning, giving or selling those names for the benefit of other people.

The attention which is now being attracted to the National School of Electricity and to its use, either with or without authority, of the names of many of our best known and most highly respected men, justifies, we think, the raising of the question:

"What is a man's duty to himself, and to the public, in lending his name to the furtherance of any public enterprise?"

Modesty forbids ELECTRICITY to assume to instruct or advise the gentlemen whose names appear on the stationery and advertising matter of the National School as the regularly constituted faculty of that institution as to their duty to themselves. These gentlemen are as follows:

Thos. A. Edison.
Henry S. Carhart.
Elisha Gray.
Harris J. Ryan.
F. A. C. Perrine.
William A. Anthony.
George D. Shepardson.
Nikola Tesla.
Michael T. O'Dea.
Brown Ayres.
Dugald C. Jackson.
Benjamin F. Thomas.
W. J. Herdman.
J. P. Barrett.

There remains then for our brief consideration the second part of our question, What is a man's duty to the public in lending his name to the furtherance of any public enterprise?

The promoters of the National School are going from town to town organizing classes for popular instruction in the science of electrics. The proposed students, many of whom can ill afford to spend the price of tuition for one term, $17.50, are induced to join the classes and pay their money because they suppose—and they have a perfect right to suppose—that the above named gentlemen have each and every one contributed some share of their individual knowledge and experience to the preparation of the lessons which they are to study. These young men, though not versed in electrics, are intelligent enough to know that the time of many of the members of this faculty is highly valuable and that their knowledge is profound. They know that if Tesla and Edison have given their time to the preparation of these lessons, the classes have offered to them, commercially speaking, a bargain.

There is, therefore, on this single ground no room for criticism against such of these gentlemen as have performed the work which the students suppose they have performed, and which the students pay for.

But as to the others—those who lent their names carelessly, or who have kept silent for months while their names have been used without warrant—we hold that they are not beyond criticism, and that they have not performed their duty to the public.

If any technical paper could secure the names of either Edison or Tesla, for instance, as associate or advisory editors, even if these gentlemen never put pen to paper in the service of the journal, it would be worth thousands of dollars a year to the publication. This is a proposition that any honorable publisher would not make, and from which both these worthy gentlemen would shrink in horror. Yet such a plan would be no more culpable on the part of the publisher than the use of these names by the National School as members of the faculty.

We have already stated the correct reasons why these and some of the other gentlemen have refrained from condemning this misrepresentation more emphatically, to wit, consideration for their friends who are sincere in their belief in the School and who are identified with it. But we hold, without fear of contradiction, that the duty of these men—public men in spite of themselves—is first to the public and then to the individual.

It is a pleasure to call attention to Mr. Edison's letter in this issue, and to state that his position in this matter is exactly similar to that of Mr. Tesla.

We commend the exquisite discretion of Prof. Elihu Thomson in keeping out of this unfortunate muddle, and believe that the men of standing in this profession have learned a lesson as to the careless giving or lending of their names which will be wholesome and lasting.

* * *

Incandescent Gas vs. Electric Light. During the past six months or more, the question of competition of the so-called incandescent gas light with the electric light has assumed such importance as to render very uneasy some of our central station men lest they, like Othello, should find their occupation gone. The feeling among some electric light men may be likened to that experienced among gas men when the electric light was prematurely announced as an accomplished commercial fact, although the degree of anxiety, now that the electric light man's turn has come, does not by any means compare with the demoralization that was created among the ranks of gas men upon a former occasion. But that there is anxiety it must be confessed, and we believe the issue must be met fairly and squarely. It will not do for us to ignore the new comer. It has come to stay if it has virtues and to die if it has not, but at any rate it is now a living question and as such must be discussed. A conspiracy of silence, which all of our contemporaries but one seem to have tacitly entered into, will not kill the new comer, nor will it assure those who think they have a right to look to any of these journals for practical information of *any* kind.

ELECTRICITY has for some time past been investigating the new competitor, and believes that it will be doing the electrical interests and the general public a favor if it gives them the unvarnished truth. Ex parte statements will do in political campaigns, but in military warfare he who, for the purpose of creating a feeling of false security, underestimates the strength of the enemy, commits as great a crime as if he represents his position falsely.

The Auer or Welsbach incandescent gas burner, to which we have reference, depends for its luminous qualities not upon the flame directly, but upon the heating effect of the flame upon a mantel or hood of some very refractory material which is suspended in the flame.

Chemists and others have long known that in the luminous flame the combustion was far from complete, and that the heating effects from gas burned in this way were far less than were possible by a different arrangement. It was found that if the proper amount of air were mixed with the gas previous to the combustion the latter and the resulting heat would be far more intense though the light-giving properties were thereby destroyed. For heating purposes, therefore, such a burner is always used, and since in the Auer-Welsbach burner the object is to impart to the mantel or incandescing fabric the maximum amount of heat with the least expenditure of fuel, the Bunsen burner, in which the gas and air are thoroughly mixed previous to combustion, is used. This flame without the mantel is practically non-luminous, but as a light-giving substance—the substance to be heated—a delicately woven fabric of refractory material is suspended within the flame, and is brought to high incandescence.

The prime condition for the success of this burner, it will be observed, is the generation of an intense heat. A second condition is that the mantel (as the incandescing fabric is called), should be able to withstand this heat without deterioration, and that it may respond readily to changes of temperature, it must be of minimum bulk. These two last conditions are antagonistic, but a mean has been struck which gives very satisfactory results both as to life of the mantel and as to its light-giving power. Like the argand burner, it requires a chimney to protect it from draughts and to conserve the heat, which, however, after it has served its purpose of heating the mantel, passes out of the chimney, together with the products of combustion, into the room. The light given is more steady even than that of the best argand burner, and it is obtained at far greater economy.

As to the efficiency of the burner, Mr. A. Crova gives the following figures, which are the mean of a number of determinations:

Luminous intensities (c. p.).........44.2 52.3 53.5
Gas consumption per hour (cu. ft.) 3.32 3.75 3.64

Some other tests show that for about 3.5 cubic feet of gas about 60 candle power can thus be obtained for one hour. But these figures are only obtainable under the most favorable conditions, viz., with a gas of high thermal power and a new mantel of the very best material.

The Welsbach Light Company at Gloucester City, N. J., who we believe are the American manufacturers, claim for their light 55 candle power with a consumption of 4.6 cubic feet of gas. It will thus be seen that the American manufacturers make a much more modest claim for the burner than their confreres abroad, and this gives considerable color to the statement that has been made to us, apparently with the best authority, that the American made mantels are of an inferior or cheaper grade than those manufactured abroad.

But whatever the truth may be, we cannot shut our eyes to the fact that the incandescent gas burner *is* more economical than anything heretofore obtained from gas as far as the ratio of light produced to gas consumed is concerned. It is also an indisputable fact that burner for burner, taking the ordinary 5 ft. burner as equivalent to the 16 C. P. electric light, the incandescent gas light is far cheaper than either gas light by the ordinary methods or the electric light. It behooves us, therefore, to see what compensating advantages the electric light has for its greater cost, or what compensating disadvantage has the incandescent gas light for its greater cheapness. It is not necessary to repeat here the arguments of superiority of the incandescent electric light over the ordinary gas light—they are familiar to all—but it may be well to notice that the argument against the electric light that its lamps require renewal from time to time loses its forces when our opponents argue for the Auer-Welsbach light, for in the latter the heat is so intense that the chimneys are liable to break, and do break to such an extent that the company is now supplying chimneys made of mica. This mica must be of a far better grade than that which is suitable for insulating purposes. It must not only be in large pieces, but it must be absolutely transparent. It must, in fact, be of a quality of which the quantity existing in the world is so limited that any new demand for it, such as would arise if the new lamp should come into general use, would push its price up to a figure that would be prohibitory. These chimneys now cost 50 cents apiece. The mantel or light-giving element of the lamp is an extremely delicate textile fabric subject to rapid deterioration and requiring frequent renewal. These mantels are now furnished for 50 cents apiece. The life of the mantel varies as does the life of the carbon filament—sometimes breaking down very quickly, at others lasting perhaps as long as a good filament; but, as is evident, where glass chimneys are used the item of repairs involves both the chimney and the mantel, which are much more expensive than the incandescent lamp.

Not long since the Munich Gaslight Company, then using many Welsbach lights in Sendlinger strasse, found as a result of two months' use that the average life of a mantel was only 180 hours and that the cost of maintenance made them more expensive than 32 C. P. electric lamps.

Since the efficiency of the Auer-Welsbach light is dependent in one way upon a greater heat production from a given quantity of the same gas, it follows that the heating of the atmosphere by such burners must be carried to the same extreme over that which has been found so objectionable in the ordinary open flame.

There is a much more serious objection to the new light, however, in the vitiation of the atmosphere which results. In the ordinary gaslight the products of combustion are chiefly inert (carbonic acid, etc.), and cause vitiation in two ways—first, by abstracting the oxygen necessary to combustion from the atmosphere, and second, by still further reducing the percentage of the remaining oxygen by the addition to it of this inert gas. Carbonic acid gas is *not* a poison, and produces no worse physiological results than would the presence of an equal amount of nitrogen in excess of that always present in the air. If, however, this carbonic acid gas comes in contact with incandescent carbon it is split up and forms with the carbon *two* volumes of another gas, which is not only *not* inert and harmless, but a most violent poison. This is known to chemists as carbon monoxide gas, and the reaction is expressed by them in symbols as follows: $CO_2 + C = 2CO$, or in words, one volume of carbonic acid coming in contact with carbon forms two volumes of carbon monoxide gas. This is the deadly gas, emitted in an impure state from burning charcoal, which has become such a favorite method of suicide in France. It is so poisonous that the use of water gas has been very largely restricted in some States because it contains large proportions of carbon monoxide in its make-up. It is the more insidious because it is odorless and its presence is only detected usually when it has already done its work. This gas which is practically absent where ordinary burners are concerned, is produced in considerable quantities in the new light, and its presence in such relatively large quantities becomes a menace to all users of it, especially in public assembly halls, theaters, churches, etc., and in dwellings. The *rationale* of its production is this: After the mantel has been in use some time the upper portion will in most cases be found to be black. This is due to a deposit of soot. The lower portion of this becoming incandescent is alternately being burned off by its union with the relatively harmless carbonic acid and redeposited. We saw the agent of this lamp the other day trying to "clear up" a mantel by varying the gas supply. He had gotten it burnt off, all except the top inch of the mantel, when we came in, and said that the soot had extended fully half way down when he commenced work on it.

M. Greihaut, the eminent French physiologist, has made a careful analysis of the products of combustion from the incandescent gas burner, and has found carbon monoxide gas to be present in the startling ratio of 1 : 4,500. Physiologically its presence has been proved by its existence in the blood of animals which had breathed the products for a few moments. A French journal commenting upon this says: "If we wish to take care of our health we must banish the Auer burner from our dwelling rooms. It is certainly very pretty to get a brilliant light in a cheap manner, but it is a hundred times more to our interest not to expose ourselves every evening to the poisoning effect of carbon monoxide gas."

In addition to this, however, the following statement will prove interesting; it is a translation from a Continental journal:

> "At the sitting of the Municipal Council at Vienna, on the 9th of August last, M. de Goetz, councilor, read a report of the Service of Constructions, on the question of introducing the Auer incandescent burners in the city schools.
>
> "The report stated that the Auer burners manifested a constant diminution in candle-power which could not be arrested even by the frequent substitution of new mantels; that besides the glare and color of the light attacked the retina of the eye, especially at the commencement, also that the frequent breakage of glass chimneys was capable of becoming a danger to the person.
>
> "Conformably with this report, it was decided by the referendum to decline to permit the introduction of the Auer incandescent burner into the schools.
>
> "The Council adopted the report and adhered to its conclusions.
>
> "If one considers (so comments the paper) that Vienna is the birthplace (*berceau*) of the Auer burner, it is impossible not to be impressed with the decision of the Municipal Council of Vienna. At the moment when myopia and weakness of sight continue more and more to develop, no precautions are excessive on the subject of lighting of schools and colleges."

Now as to the quality of the light, the question arises, is it such as to make it popular with the people? Von K. Mützel has carefully analyzed the light by means of the Glan-Vogel spectroscopic photometer, and has determined the relative proportions of the different colored light rays emitted. He finds a predominance of the green rays, and it is the presence of these that gives the light and all upon which it falls the ghastly hue which has been so much noticed in the Auer-Welsbach burner.

This will unfit it for the theater or the ballroom, and make it unpopular with the ladies, for there are few of the latter whose complexions are good who will care to appear in evening toilet with corpse-like complexions, or have their make-ups exposed, as they most surely will be, by the incandescent gas burner if they are so unfortunate as to be compelled to resort to any such expedient. To such an extent is this true, that we believe it would be suicidal for any theater to adopt this light, and that they would open to empty houses should they attempt the experiment.

But the fact remains that the new light comes as a most formidable competitor, and it must be met. There are always those who are running after strange gods, and it must be confessed that some of our central station managers are making strange gods, or *any* change, desirable to this class by furnishing their current at too low a pressure. With the cheapening of incandescent lamps, the pressure on the mains has by no means kept the pace which a less cost for renewals would warrant, and the lamps are run too low. We believe it would be to the interests of everybody concerned if the voltage were raised considerably so that the lamps would give a bright, cheerful light instead of the somber, depressing glow which renders some change, even at the expense of bodily health, desirable to many.

* * *

WHO would suppose that the Coffinesque influence would ever extend so far over his subordinates that S. D. Greene and C. T. Hughes would appear in the public prints as the associates and confidants of a gang of thieves trying to rob the city?

* * *

WITH the boodling question at Toronto we have little to do at present. But the revelations made, that the Brush Company, nine-tenths of whose stock is owned by the G. E. Company, is still engaged in the business of sandbagging the licensees of the latter company, are worthy of note.

An Electro-Medical Fraud—II.

ELECTROPOISE, GROSSEST OF THERAPEUTIC HUMBUGS.

What is the Duty of Reputable Publications?

> "The one discordant note in all this great display of genuine scientific and engineering work was found in the fact that in this same temple of science—in Electricity Building itself—naked imposture, quackery in the form of so-called electrical belts, hairbrushes, insoles and what not, had obtained a footing and stalked forth unabashed. No words of condemnation can be too strong to be applied to the parasites who, in the guise of healing and benefaction, succeed in extracting perhaps the last money from the sick and suffering for their worthless trumpery."—PROF. ELIHU THOMSON, in the *Engineering Magazine*.

"The History of a Publishing House" is the title of an interesting article in *Scribner's Magazine* for December. No one can read it without recognizing the pride which the present heads of the house of Scribner feel in the career of that concern, started nearly forty years ago. That pride is felt to a certain degree by the general reading public, who all rejoice that America has produced not only this but other successful publishing houses who have never given the weight of their names to bad books or bad literature of any kind.

This universal feeling of satisfaction must, however, be seriously impaired, at least so far as the electrical and medical professions are concerned, when the thousands of readers turn from the article mentioned in the December *Magazine* to the advertising pages and see there occupying, as far as the sanction of the publishers goes, as honorable a position as that of the makers of good books themselves, the advertisements of such barefaced frauds as the "Electropoise," "Actina," and an "Electro-magnetic Rheumatic Ring."

Turning to *Harper's Magazine* for December, we also find two of these same advertisements.

We charge these two magazines, issued from the press of our most conservative and highly respected publishing houses, with thus aiding and abetting a despicable fraud upon the public. They would doubtless plead innocence, on the ground of ignorance. Is such ignorance excusable or pardonable?

We are well aware that the promoters of these three electro therapeutic humbugs can furnish testimonial letters from many intelligent people who think they have been cured by their use, and so could any of the quack medicines whose advertisements are generally declined by these and other leading journals.

The question we wish to ask is this: What is the duty of reputable publishers to their constituents in the matter of accepting or rejecting advertisements?

We have always held, and still hold, that any reader of the religious press, the literary monthlies, or any other high class publication, was justified in supposing that any advertisement in such publication was that of a legitimate business, and in favoring them with patronage if so inclined.

This is the popular view, and if it were not so the advertising pages of these magazines, etc., would not be patronized so liberally as at present.

Yet if any of these publishers had submitted the "Electropoise" to any six physicians or six electricians for an opinion they would have got a unanimous verdict, "A swindle and a fraud."

Every man who sends $25 to the Electro-Libration Company for one of these devices is robbed of his money, and this as far as may be with the assistance of *Scribner's Magazine*, the *Review of Reviews*, *Harper's Magazine*, the *Literary Digest*, and so on throughout nearly the whole list of our best read and most admired publications.

Is it not time for the scientific and medical press to protest with vigor, at least until the electro-medical frauds are driven to conduct their business as other disreputable businesses are conducted—under cover?

Electricity is convinced that it is, and will continue its campaign until there is manifest a higher public sentiment in regard to these matters.

It is not long since a vender of electric belts, etc., was sent to prison in England for five years with a £500 fine added. It should not be long before some of the same class of humbugs are similarly treated in America, and Electricity proposes to do all in its power to bring this about.

After our conclusive exposé of the "Electropoise" last week we sent a proposed advertisement, of which the following is a copy, to each of the religious papers mentioned in our list last week as having aided the Electro-Libration Company in selling a worthless instrument, costing the makers less than 50 cents, to their ignorant readers for $25:

[COPY.]

"ELECTRICITY,"

one of the leading electrical journals of the country, is conducting a vigorous campaign against the various electro-medical humbugs which have so successfully misled the public, the existence of which is felt to be a disgrace to the science by all electrical men.

Any persons who have been misled by the purchase of the "Electropoise," sold by the Electro-Libration Company in various cities, will learn something of interest by communicating with this journal.

B. E. Greene, Publisher,
6 Park Place, New York.

The following are samples of the replies received:

From Dr. Field's Paper.

To the Editor of Electricity.

Dear Sir: As we understand that the advertisement which you kindly sent us on November 20 is libelous in character, we are obliged to decline accepting the same. Yours very truly,

Henry R. Elliott,
Sec. and Treas.

Publication Office of the *Evangelist*, New York, Nov. 22.

From the "Observer."

To the Editor of Electricity.

Dear Sir: Your favor is received. We should not, under existing circumstances at any rate, wish to publish the advertisement you send.

Yours very truly,

New York Observer,
by J. A. Offord.

The New York *Observer*, New York, Nov. 22.

We call attention to this matter to show the hypocrisy of a part of the religious press. Two hours of proper investigation would have shown them the justice of our charges against the "Electropoise." But the Electro-Libration Company are liberal advertisers and must not be offended.

WE OFFER APOLOGY TO THE "SUNDAY SCHOOL TIMES."

In common with the other religious papers we wrote to the editor of the *Sunday School Times*, charging that journal with wrong conduct in publishing the "Electropoise" advertisement. The following reply was received:

To the Editor of Electricity.

Dear Sir: It is always difficult to prove a negative, but it ought not to be difficult to prove a positive assertion. The *Sunday School Times* rejected an advertisement of the Electropoise before the members of the electrical profession seemed to be aware of its unsavory nature. Now that you repeat your assertion that "the *Sunday School Times* has published an advertisement of the Electropoise," I ask you to please refer to the issue of the paper in which that advertisement appeared, or to admit that you have made a mistake.

If, indeed, any such advertisement has ever appeared in its columns, no one in the office is aware of the fact. Yours truly,

H. Clay Trumbull, Editor.

The *Sunday School Times* Editorial Rooms,
1031 Walnut street, Philadelphia, Nov. 24.

When we prepared our article we were informed by the editor of the *Christian Nation* that he had accepted the advertisement because it had been investigated and accepted by the *Sunday School Times*, and that their acceptance of it was sufficient warrant for him.

The *Sunday School Times* has not printed the advertisement, and we offer a humble apology to that journal, saluting it as the highest type of journalism now before the American reading public.

Another error made by us was in leaving the *Outlook* out of our list. This journal printed the advertisement a few weeks ago, having been satisfied that it was proper to do so. The publishers may be satisfied, but how about the readers of that journal who have been robbed of their money?

One of the amusing incongruities that have come to the surface in this investigation is noticed in the *New York Observer* for November 1. On page 422 it gives a quarter of a page to an advertisement of the Electropoise, which consists chiefly of an indorsement by the venerable Archdeacon Gates of Missouri, while it devotes two-thirds of a column on page 409 to an editorial devoted to "Doubtful Teaching About Healing."

The following letters have been received, showing, we are glad to know that Electricity does not stand entirely alone in this crusade:

Dr. Tieste Investigated it Two Years Ago.

To the Editor of Electricity.

Dear Sir: A little more than two years ago my attention was first called to the Electropoise. One of my patients had heard such reports that he desired to make a trial of it. I had no objections, and at his solicitation I purchased an Electropoise. It was never used, for the reason that the patient saw plainly after my explanation that it could have no virtue. It was returned to me and I determined to cast aside my prejudice and use it on myself. I carefully read the directions, arranged it so as to get the maximum power, applied it, went to bed and awoke in the morning as usual, having experienced no sensation of any sort whatever; whereas, if the little "Victory" had the power ascribed to it, I should have been in a state of collapse. I submitted the cylinder to my friend John A. Barrett, an expert electrician; it was opened and found to contain what your analysis gives—viz., sulphur and graphite. The Electropoise is absolutely inert. Very truly,

L. E. Tieste (M.D.)

6 Lafayette ave., Brooklyn, N. Y., Nov. 24.

Dangerous in Results though Harmless in Action.

To the Editor of Electricity.

Dear Sir: Allow me to commend the stand which your paper has taken in the way of exposing at different times some of the multitudinous patented frauds which unscrupulous people impose upon the credulity of the unthinking and unknowing public.

In most of the States we have laws which are intended to prevent persons without adequate medical training from taking upon themselves the responsibility of giving advice in cases of sickness, for although the remedy recommended may be harmless in itself, still by employing it valuable time is often lost before the proper therapeutic agent is applied, and the loss of a few days may permit the disorganization and destruction of the delicate tissues of the body. Indeed, with such organs as the eye, gray matter of the nervous system, and white fibrous tissues lining the heart, blood vessels, peritoneum, etc., a few hours of unchecked inflammation will damage them irreparably.

I hope the time may come when the public will be educated to a point where quacks with their patent nostrums will no longer be able to stand in the clear light diffused by general intelligence. Yours very truly,

Henry H. Morton (M. D.)

40 Schermerhorn street, Brooklyn, N. Y., Nov. 24.

[Dr. Morton is president of the Brooklyn Dermatological Society, dermatologist to Kings County Hospital and Long Island Hospital Dispensary, expert on contagious diseases to Brooklyn Health Department, etc.]

Dr. Rockwell's View.

To the Editor of Electricity.

Dear Sir: In reply to your inquiry as to my opinion as to your course in endeavoring to expose what you term the falsity of the therapeutic claims of the so-called "Electropoise," allow me to say that you are to be commended for any effort put forth in the direction of suppressing quackery and dishonest claims wherever and by whomsoever made. A. D. Rockwell (M.D.)

113 West 34th street, New York, Nov. 26.

Parasites and Vermin.

To the Editor of Electricity.

Dear Sir: I am glad to congratulate you upon the stand you have taken in exposing electro-therapeutic humbugs of all kinds.

They are the source of humiliation alike to the medical and to the electrical profession; they are the parasites and the vermin which infest true science. And the worst feature of it all is, that honored names of ignorant but guileless citizens are secured to vaunt these frauds and that respected journals advertise them. It is "business," no doubt, but what sort of business? I hope you will go on with this fight, and I am sure you will find sympathy and aid. There is no doubt in my mind that every claim made for the Electropoise is false. Yours very truly,

Wm. J. Morton (M. D.)

19 East 28th street, New York, Nov. 27, 1894.

[Dr. W. J. Morton is professor of diseases of the mind and nervous system and electro-therapeutics in the New York Post-Graduate Medical School and Hospital, and visiting neurologist to Randall's Island Hospitals.]

From a Well-known Electrician.

To the Editor of Electricity.

Dear Sir: Having noticed in your publication of November 21 an interesting discussion of an "Electro-Medical Humbug" called "Electropoise," and of the questionable position taken by leading religious papers in selling their weighty influence to the uses of such business, I desire to communicate to you my earnest belief that you have assumed a high and worthy attitude in this matter, and have undertaken to give practical effect to one of the most admirable functions of a Scientific Press.

I am the more interested in this particular case from the fact that three years ago I was called upon to examine an "Electropoise" outfit, by a physician into whose hands the apparatus had come through a patient of his who had been led to procure it by some advertisement or recommendation. I read the directions accompanying the outfit, and examined and tested and finally

(*Continued on page* 238.)

Popular Electrical Science.

III.

Some of the Less Understood Electrical Phenomena—The Alternating Current and Its Manifestations—Electro-Magnetic Induction.

BY NELSON W. PERRY, E. M.

By the above title I do not mean to imply that the several phenomena which I shall attempt to explain here are not well understood by those who have made a specialty of studying them, but that the public at large, which frequently hears them spoken of, has little idea of their meaning. Let us take the alternating current, for instance. Doubtless everyone knows what that is from its name, but there are various phenomena inseparably connected with alternating currents with which they are not familiar, a speaking acquaintance with which, at least, will be necessary for a clear understanding of many of the applications of electricity which it is intended to describe in the course of this series of articles.

If water be flowing in a pipe we have no means whatever of knowing the fact without tapping it. Its flow is confined wholly within the pipe and produces no phenomena outside. If an electric current flows along a conductor, however, it produces phenomena in the medium surrounding it by which not only the flow but its direction, and indirectly its quantity, are made manifest. Thus, if a compass needle be brought near a wire, the current flowing along that wire will be made evident by the deviation of the needle either to one side or the other as the compass is held above or below the wire. If the current be reversed, the deviation of the needle will be reversed. That is to say, if the needle in the first case were placed under the wire so that the current flowed from N (north) Over the wire to S (south), the north end of the needle would deviate to the E (east). An easy way of remembering this rule is to remember the word which is formed by placing the capitalized letters together in the order in which I have used them thus, N O S E. If now we reverse the direction of the current so that it flows from S (south) to N (north), Over the needle, the latter will be deviated to the W (west). We have here another mnemonic in the word S N O W. If, however, the current continues to reverse its direction very rapidly, the impulses upon the needle follow each other so rapidly in opposite directions as to practically nullify each other, and the needle remains at rest and this test for current fails.

There are other tests, however, not depending upon such crude appliances as the magnetic needle, by which these oscillations can be detected. If the influence of a steady current merely deviates a needle and holds it in its new position, the current performs work only while the needle is being pulled over to its new position. It does no work whatever in holding it there any more than a man is doing work while holding a pound weight in his pocket. If, however, his pocket has a hole in it, and every time he puts the weight in it falls through and he is engaged continually in picking the weight up from the floor and putting it in his pocket, he *is* doing work. But what becomes of the work he has done? He seems at first sight to have accomplished nothing. To be sure every time the weight falls to the floor the net result is nothing—the weight is exactly where it was before he commenced putting it into his pocket. But every time he has lifted that weight he has endowed it with a certain quality which it does not possess while upon the floor. By the exertion involved in lifting that weight he has endowed that weight with the quality of being able to itself give out or perform an equivalent amount of work. Thus by lifting the weight he endows it with the *ability* to do work. The weight in dropping may raise another nearly equal weight to the same height, in this way, by *doing* work itself, endowing the second weight with like power. And thus the power exerted by the man might be transmitted through a long series of weights to any distance we choose (provided of course there is no friction). The energy of the man would thus be *propagated* to a distance—every other weight falling or giving out energy as the alternate weights are lifted or are absorbing energy. Perhaps a better analogy would be found in the wave motion of water. Drop a stone in the middle of a pond of water, it will give rise to a wave which, spreading out in ever-increasing circles, will finally swash up against the shores. A portion of the energy which the stone has expended will thus be transmitted or propagated by the wave to the shore where the work it does is made manifest in the erosion which follows. It will be clear that this propagation of energy is not due to any *current* of water, for there will be no flow from the center to the circumference of the basin. The particles of water which are engaged in this propagation have no motion of translation in the direction of propagation, but have a slight motion equal to the distance of the crest above the trough of the wave. If we should place a line of floats in a straight line from the point of disturbance to the shore, we would find that each one would rise and fall nearly vertically as the wave passed on.

If now we should take a stick and churn it up and down in the water, it would give rise to a series of waves following each other in the same succession as the up and down motion of the stick. If at some distance we float another similar stick in a vertical position it will oscillate as its float rises and falls on the waves exactly in rhythm with the first stick but will tend to smooth down each wave as it passes. If the stick have inertia it will tend as it rises and falls to give rise to another system of waves which will start out with it as a center and extend indefinitely in all directions. These waves, of course, cause other light floats to oscillate, and these again may give rise to new systems of concentric waves, and so on almost indefinitely.

Now, all space is filled with a something we call ether which is peculiarly sensitive to disturbances such as we have described on the surface of the water, and which propagates similar waves with remarkable facility. This medium, however, is not readily disturbed by mechanical motions, but when it is disturbed along any path these waves pass outward in concentric circles with little loss of force into the infinitudes of space. If now the stick in the water be typified by an electric current that vibrates back and forth, the latter will set up these ether waves of a very similar kind. The alternating current of electricity is the analogue of the churning stick. The ether waves are the analogue of the water waves. If now there be another electrical conductor parallel to the first one, we have the analogue of the second floating stick, and like the latter, if it be so placed as to be affected by the ether wave, the electricity in it will be set in oscillation just as was the second stick in the water analogy—an alternating current will be set up in the second wire for every alternation in the first. This phenomenon of the propagation through space from one conductor to another one parallel to it, is what we term *electro-magnetic induction.*

If we should draw a smooth stick with a perfectly uniform motion either downward *into* the water or *upward* out of the water, it would set up no surface waves however long this might be continued, because if, as would have to be the case, the stick were practically endless, the drawing of the stick downward or upward would not cause the displacement of either more or less water, nor would the friction against the water be varied. If, however, we introduce the end of the stick into the water it immediately displaces its own volume of water, pushing it out radially to form the crest of a wave; or if we pull the end of the stick out of the water it leaves a vacancy which has to be filled up and we have the trough of the wave; or if we churn the water by a vertical oscillation of the stick, the friction of the latter as it goes down or up will carry some of the water with it and give rise to waves; or if the motion of the stick *varies* in *speed*, or if it be not of uniform section, even though its motion be continuous in one direction, it will also give rise to waves and these will pass out over the surface of the water until the energy they contain has been all imparted to floating particles which rise and fall or it is consumed in the work which the waves themselves do on the shores of the pond. So it is that a perfectly steady electric current in a conductor sets up no current in neighboring conductors, because so long as it *is* steady it sends out no waves. But when a current is started or stopped, or it varies in size, these ether waves are set up and pass out into space to produce oscillations like those which give rise to them in whatever conductors they may come in contact with

Now we know that wave motion is much more readily propagated in some liquids than in others. In some the waves would move much faster than in others, or two liquids might propagate the waves with the same speed, but they might be much higher in one than in the other. If the latter were the case, and we should imagine that in the pond of water there were a well-defined zone of some other liquid of the same specific gravity which would propagate higher waves than the water, we would find the floats situated in this zone bobbing up and down through a greater vertical distance than those situated in the water, and if we could imagine such a zone of the second liquid extending out radially, or like spokes of a wheel from the hub, from the stick with which we were churning, we would find more energy propagated along this ray than along any of those consisting of water.

Now the ether, which is the electrical analogue of our water, pervades all space—pervades all matter, as well as empty space—and material obstructions, as a rule, have no more perceptible effect upon the propagation of these waves than glass has upon light waves. If the material obstructions happen to be what we call electrical conductors, they will have oscillating currents set up in them which will tend to dampen down the waves, to be sure; but what I mean is, that it is a general proposition that in our ethereal ocean these waves are propagated in all directions with the same facility, irrespective of the material obstructions that may be in the way. There is one very marked exception to this rule, viz., that the ether that pervades metallic iron transmits enormously higher waves than does the ether which pervades any other material substance. If, therefore, we wish to transmit the largest amount of energy possible from one oscillating or alternating or variable current to another one at a distance, we simply connect the two by a canal of iron along which the waves of highest crests will be propagated, and the second conductor will receive vastly more energy from these taller waves, i. e., the electricity in the second conductor will bob up and down through a much greater amplitude of path than will that of conductors placed less favorably.

A practical application of this kind is found in the magnetic transformation or the induction coil. The primary coil, or the one in which the electrical oscillations are created, is placed with its plane parallel with the secondary coil, and then the two are connected by a canal of iron along which the waves of the greatest amplitude are propagated. The result is that under these conditions very nearly as much energy can be gotten out of the secondary coil as was impressed upon the primary. In practice it is found possible to propagate in this way as high as 97 per cent of the energy of the primary coil, thus constituting this device the most perfect transformer of energy with which we are acquainted. But energy is also transmitted through space in the same way without the assistance of iron, and will be transmitted from one to the other of any two parallel wires regardless of any material obstructions which we may interpose. The so-called cross talk on telephone wires, where a person listening on one circuit can overhear the words of another on a totally different and disconnected parallel circuit, is an instance in point.

This phenomenon of induction is to the layman perhaps the most mysterious of all the electrical phenomena, but it is one that has proved so useful at times to the electrician, while at others given so much trouble when its effects have not been fully anticipated, that it is necessary for us to form some conception of its nature before we can intelligently understand much of electrical action.

Conduit Electric Railways[*]—3.

Is There a Solution of the Problem?

BY JOSEPH SACHS.

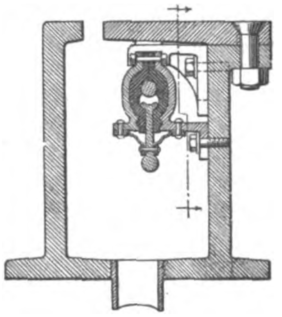
In conclusion I would say that I believe, as I have repeatedly said, that we can solve this problem. I have shown you some of the ways in which it has been attempted to solve it and some of the ways in which it may be solved. Some of you undoubtedly have other ways, and I should very much like to have you discuss the matter, and would, in fact, invite discussion on the question; it is all-important—it is one that we are coming to. We have got to have an underground or conduit system for our large cities where they will not let us use a trolley, and from the fact that at least three companies—three large corporations—that I know of are trying the ordinary open-slot conduit, I think we will shortly see something in actual operation.

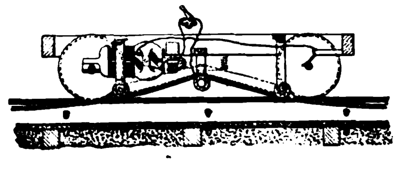
But before closing I want to afford you more or less of a treat in explaining a system a stretch of which will be installed upon the Lenox avenue cable road of the Metropolitan Traction Company. It has been devised by the engineers of the General Electric Company, has been approved by their most eminent men, and contains various features, some of which I have already described. The ordinary conduit yoke is taken, and at the manholes, 30 feet apart, placed upon suitable supports, insulators which are of rectangular form are located. They are supported in cups and imbedded in sulphur; these insulators are of soapstone and fastened to the top is an arm of iron. There being two conductors used there is no structural return. To this arm is fastened the contact conductor which is of channel iron. The contact shoe comes down through the slot and has two arms which press outwardly from the center, supporting the bar against the contact rails, making a continuous rubbing contact. The insulators are located in the manholes and are easily accessible; they are quite a distance apart, and the voltage, last of all, is low, it being intended to use about 250 or 300 volts. I want to point out the fact, without criticism, that the conductors are very nearly directly below the slot, which was apparently the objection in some of the first systems, but the peculiar construction and location of the insulators in this system may prevent any trouble from this source.

DISCUSSION.

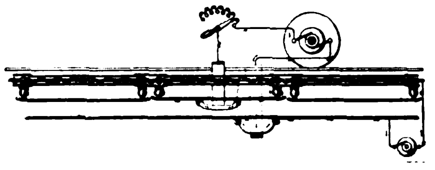
Mr. Townsend Walcott—Mr. President and gentlemen: It does not appear to me that there is any advantage about three wires under the circumstances named. I object to a three wire system as being inconvenient. If we build a conduit that can stand 220 volts it will be a great deal better to use 220 volts. Now, Mr. Sachs says that he wants to get his voltage as low as possible. Get down below 500 volts, then the two wires in that three-wire system—the two outside wires—would not be much over 500 volts, and it would not be very hard to build a motor that would stand across the two outside wires, and there would be no use for the neutral wire.

Mr. Sachs—I am somewhat hasty, perhaps, in trying to answer Mr. Walcott right away, but I simply proposed the three-wire system as a possible solution; there is certainly a saving of copper. We have a low voltage between this wire and the structure and between that wire and the structure; but we would certainly have twice this voltage between the two wires themselves. This would be the case if we put both wires in a single conduit, and there would perhaps be no great advantage in that case. In a double-track system, however, there is certainly a big advantage in cost of copper. But I merely proposed the matter.

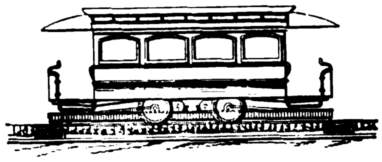




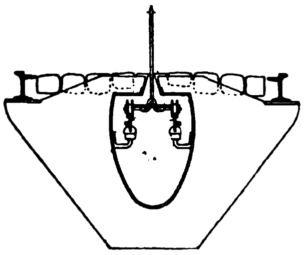
METROPOLITAN SYSTEM.



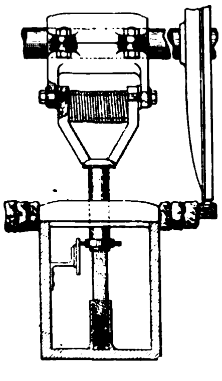
THE ASHLEY SYSTEM.



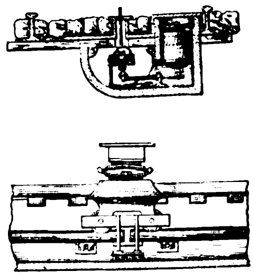
DEWEY'S SYSTEM.



HEWETT'S SYSTEM.



HENRY'S SYSTEM.



LAWRENCE SYSTEM.

Mr. Walcott—That is the point I was speaking of. When it is perfectly easy to build a motor to connect to the two outside wires what advantage there is in using the neutral I do not see. You do not decrease the insulation any by using the neutral wire.

Mr. Sachs—You may not decrease the strain on the insulation between the outside wires, but you decrease the cost of copper when equipping two tracks.

Mr. Walcott—What is the object of using a low voltage to begin with? Is it on account of the trouble of insulation?

Mr. Sachs—You may not perhaps have any very great advantage in using a single conduit with the two outside wires located directly in the conduit, but where we have, for instance, two conduits and simply a single wire in each conduit, as I described, it strikes me that there would not be very much chance of the wires coming together or very much chance of leakage, and then you get the advantage of the lower voltage at a lower cost of copper. I simply offer the suggestion.

Mr. Walcott—As I understand it the only object in using a low voltage is on account of the difficulty of insulation.

Mr. Sachs—Yes.

Mr. Walcott—I don't see that there is anything to be gained by having the three-wire system. The object of using three wires, as I said before, is to have a low voltage.

Mr. Sachs—The difficulty of using the two-wire system or the high voltage system is because we cannot make the conduit stand the strain of high voltage. Suppose we have here a 500 volt system and use a single wire and structure return. Now all you would have would be one insulator here to stand the strain of 500 volts.

Mr. Walcott—Yes.

Mr. Sachs—Now in the same conduit let us place two wires and then we have two insulators to stand the 500 volts. Now all there is done in the three-wire system would be that one of these wires would be placed in one conduit and the other in the other, the conduit forming the neutral. We would now have the same amount of insulation to stand the strain of 500 volts, but the copper formerly used for one track would be used for two. A graphic illustration would be better than a verbal one: there are two conduits (indicating); now, what have we got? Here are two conduits side by side; with a two-wire system and double wire we would have four wires in both conduits; with the three-wire system only two. While the voltage between them remains the same the voltage between each and the neutral (the structure) is one-half, and therefore the insulating medium need only be one-half. We thus get a low voltage on each conduit, a lower cost of copper.

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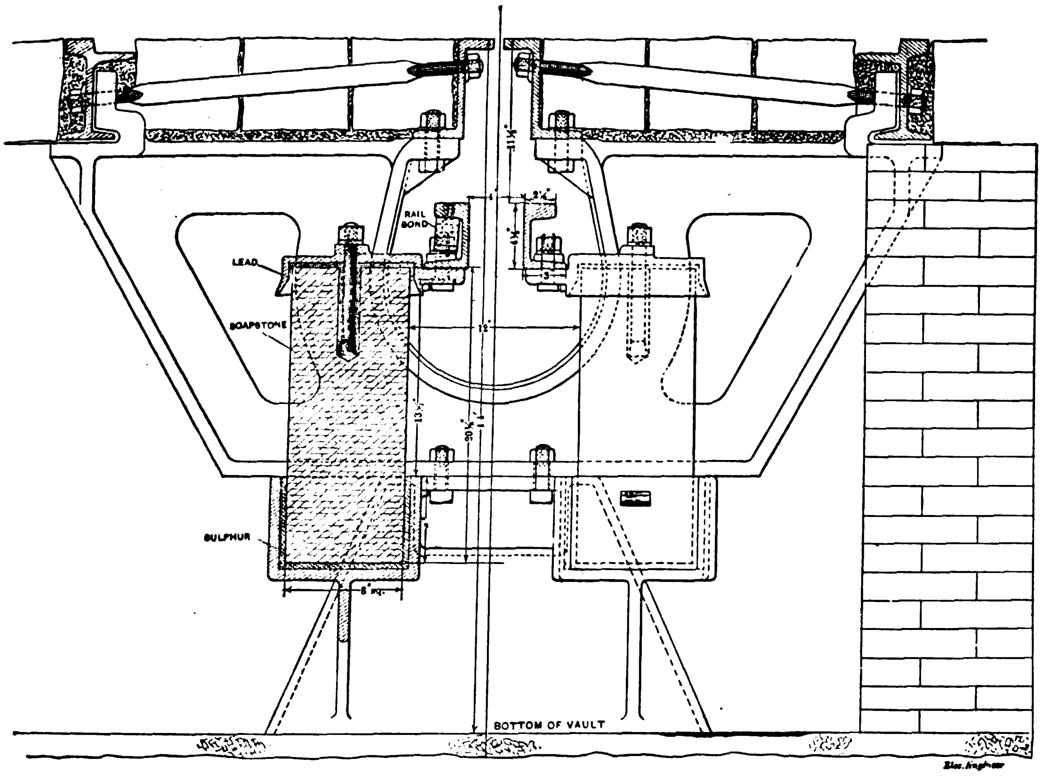
[*] Abstract of a lecture delivered before the New York Electrical Society, November 1.

The President—We have with us this evening a gentleman who knows a great deal about this subject. Mr. Stetson is here and I hope we shall hear from him.

Mr. Albert Stetson—I do not know that I have anything more to say than to congratulate Mr. Sachs very highly on his excellent paper. I have been very much interested in Mr. Sachs's statements. We have had a great deal to do with this class of work. I have a great many gray hairs from it, and I hope some of those days to have the pleasure of showing you one of these conduits, one which will be an improvement over every one we have had. I believe the complete question in reference to a conduit is to persuade business men—men who run railroads for money—that they could get something sufficient to answer their purpose. You can put down an expensive conduit in but few places in this country. Your conduit has got to be cheap or you cannot put it down. When the car is tied to a cable it is moved cheaper than it is by electricity. That is what I think we have got to face in our work on the underground conduit system. Probably with the increased cost of real estate, with less plant required for the electric traction, the electrical engineer would claim the advantage; but he has got simply that margin, in my opinion, to work on. I hope, instead of hearing from those who have worked on it and who have already said a good deal on the subject, to hear from some of those who have new ideas, perhaps have some new system of traction to bring up.



Lenox Avenue Railway Conduit.

The President—There is one point I think Mr. Stetson is right about. If you expect to find philanthropists among street railway people you will have to travel a long distance. There is one point that has to be borne in mind, and which affects the conduit system, and that is the cost; not only the cost of the track equipment—for in considering the total cost per track mile we must not only take in the track alone, we must take in the total cost of equipment per mile of track. Now the great argument that has been advanced against all electrical systems has been that owing to the cost of electrical machinery in the car, the motor equipment, when you come to take a mile of track equipped with so many cars per mile, the total cost is greater than with the cable system, because once given a cable system the car itself costs relatively little. Perhaps there is no person better able to discuss that fact than one who has had cable traction experience. I am happy to inform you that we have with us this evening one of the best there is on the subject of cable traction, a man who has had the control of a work that is read in all countries and which contains the most up-to-date, reliable and authentic data on the subject of traction of all systems—a man who has traveled the length and breadth of this country in investigating the different systems and who is thoroughly familiar with them in every form. I hope, therefore, that we shall have the favor of a few remarks from Mr. C. B. Fairchild, the editor of the *Street Railway Journal*.

Mr. C. B. Fairchild—Mr. President and gentlemen: After such an introduction it would be very difficult for me to sustain that reputation, I fear. I am much pleased to be with you. It is the first time it has been my privilege to meet with you, and the Paper has suggested a great many thoughts to my mind. If I were in my usual health I would be very glad to elucidate, but if you will bear with my infirmity and allow me to just make a few suggestions, perhaps you will be able to think on a little different line in regard to this subject. In the first place the president, in his introduction, spoke of the necessity of an underground conduit system. Now, it is a question with a good many whether there is a demand, any extraordinary demand, for an underground system. The question has been studied quite thoroughly and some of the large electric companies have made designs for an underground system, and one of the companies, which at one time proposed to put in a system here in the city, withdrew from the field. After studying it they realized, they told me, that there was not a demand for it and that a successful underground system would be a great calamity for the street railway interests of this country from the fact that if one were adopted every little city throughout the country would demand that all the wires be put underground, and it would ruin nine-tenths of the street railways of this country if they were compelled to operate under such a system. So it is a question whether such a system is demanded or not. In cities where wires have been put up there is no great objection to them. I am simply quoting—I am not giving my opinion, I am quoting what I have been told.

In regard to the later systems and the cost, I had the privilege last week of inspecting the drawings that have been provided by the Metropolitan Street Railway Company of Washington, which company has been obliged to put in the underground system by act of Congress. All the street railways of the District of Columbia are directly under the control of Congress, and Congress passed a bill at the last session requiring them to put in the underground system, as overhead wires were not allowed in the city. They do not allow them to put in a cable and they must put in the underground system, and they are going ahead with the work. The yoke is about the same as has been used in Washington on the cable construction—a little heavier perhaps—the conduit is about 25 inches deep and 18 inches wide, and the conductor is the same as illustrated in the General Electric Company's system—4 inch channel iron, 4 inches deep—supported, however, from the top instead of from the bottom. They are to be supported on double corrugated porcelain insulators headed with trunnion bands to provide for expansion. The cost is estimated to be more than the cost of cable construction, and that is a point that I have learned from the engineers. Even the Siemens-Halske Company, who proposed at one time to put in an underground system, told me the estimated cost would be more than the estimated cost of ordinary cable construction. But that depends on the condition of the street. I am asked what is the cost of cable construction. If there are obstructions in the street, as in the case of Broadway and Third avenue, the cost is very large. I suppose neither of those roads was built for less than $150,000 a mile of single track. I know that is the figure for one of those roads; I will not tell which. Cable construction is now being put down in Washington very cheaply indeed—about $36,000 per mile single track; steel rails are cheap and cable construction is put down cheaper than ever before; but ordinarily the construction will be from $60,000 to $75,000 per mile of single track.

The lecturer did not speak of another of the difficulties that are met with in underground conduit construction; he said very little about the conductors or about the liability to change. In the Halske system they are using an iron conductor. The difficulty with copper, I suppose, has already been touched upon, but it is pretty difficult to provide for the expansion and contraction, and that is a very important fact in connection also with the iron conductor. But I was told the other day in Washington by a manager of a system there that the temperature varied on their line from below freezing to 145°, so that they were having a great deal of difficulty there with their conductor, so much so that they proposed to employ a copper conductor, angle bar backed by an iron bar. The size of the wire used now by the Love Company is about one-half inch in diameter. Then again the difficulties of under-running contact. The Love conduit has an under-running trolley and the Siemens-Halske has a side contact.

Now I fear they will have difficulty in the Washington system in using a porcelain insulator. I think it will require some material on which the moisture will not condense as on porcelain; probably mica or something of that kind. The great difficulty in the underground system in this country has been with the moisture that collects and the gas in the conduit. There are very serious difficulties that those of us who have not had actual experience cannot appreciate. I remember in studying the system in Boston, about two years ago, where it was impossible to tell what became of the current. Perhaps the cars would run all day without any difficulty—everything perfectly right; begin to run the next day and then the current would be gone, and they would hunt for an hour or two hours and not find what had become of it, and presently it would be all right and the cars run. I never knew and have never heard an explanation how the current went away. It seemed to go through the gas or moisture that accumulated in the conduit. It is a good conductor; it is different from anything I have ever known. What it is the engineers have never, so far as I know, been able to discover. Then again the moisture in a conduit of that kind is very great, If you have never been down in the cable conduit, or looked into one, or saw a cable come through after making a trip, you will hardly realize the filthy condition of the interior of those conduits, and it is simply impossible to prevent the current from vanishing without increasing the insulation, and there is no economy in that. I might say that you cannot run an economical street railway with a 300 volt current—we must have at least 500 volts,—and I find in my travels through the country that the roads run up to 550 and 600 volts.

Now as to the cost. It will cost considerable if you put in a large conduit, 25 inches deep—the Washington conduit is about 25 inches. You have got to provide a strong support for the surface of the street, as you do for cable, and it will require just as heavy and strong a yoke for electrical cars as for cable. In fact it will require a heavier construction to support the electrical cars over the conduit than with the cable, and the cost will be correspondingly great.

(*To be continued.*)

SOCIETY NEWS.

A. I. E. E.

At the meeting of Council, held at 26 Cortlandt street November 21, the following Associate Members were elected:

Joseph Appleton, George F. Archer, Frank M. Ashley, Charles Blizard, C. G. Davenport, W. S. Hadaway, Jr., William L. Hedenberg, Charles K. Munns, A. E. Brooke Ridley, Francis G. Robinson, William Wesley Varney.

The following Associate Members were transferred to full membership:

H. S. Sands, Norman N. Ross, W. C. Cheney, Fred. A. Bowman, F. W. Tischendoerfer.

At the Institute meeting, held at 12 West 31st street in the evening, President Houston in the chair, a paper was presented by Professor George D. Shepardson, of the University of Minnesota, entitled "Suggestions for an Index of Engineering Literature." In the absence of the author, Mr. T. C. Martin read the paper and opened the discussion, which was participated in by Messrs. Crocker, Caldwell, the President and the Secretary. Written discussions were also communicated by Messrs. Carl Hering, J. Stanford Brown, M. Osterberg and Professor Goldsborough. Professor H. J. Ryan also sent in a communication upon the subject of "Reactance," in discussion of the paper read at the Philadelphia meeting.

The Harrison Telephone Company.

At a recent meeting of the leading stockholders of the Harrison Telephone Company at Chicago ways and means were considered for pushing vigorously the campaign against the Bell Company. Among those present were Messrs. W. R. McMillan, P. A. B. Widener, George Elkins, Stephen B. Elkins, William C. Whitney, R. C. Kerens, Patrick Egan, of New York; John R. McLean, Henry Villard, George E. Peck, William Warner and Robert H. Porter.

THE NATIONAL SCHOOL.

"Electricity's" Charges Fully Verified.

> FACULTY—(*Amer. Colleges*) The president, professors and tutors in a college.
> DEAN—(*U. S.*) A registrar or secretary of the faculty in a department of a college.
> REGISTRAR—A recorder, a keeper of records.
> —*Webster's International Dictionary.*

ELECTRICITY'S views of the National School have already been clearly expressed and are now well known. We have used strong language, because we believed nothing less would be effective.

The following communications are printed with little comment, and are, we think, in themselves evidence that we were correct in our charges of misrepresentation, deceit and other wrong-doing.

It has not been our intention to wage war against the School, but against the bad methods and the misrepresentations. We believe in the fundamental principles of the School, and under proper management it would have our hearty support.

The attorney for the School has now written to Mr. Barrett that Mr. Hornsby will have to be dropped or the School will go to pieces. This suggests a move in the proper direction, but it will not be enough. There are others equally incapable and dishonest who must be retired.

Then there are plenty of capable, honorable men to take hold of the enterprise and make it the success it ought to be.

Under its present control it is destined to disgraceful disintegration.

The accompanying reproduction of a recent official letter from the New York branch shows either that Mr. Edison or Mr. Lavers is—mistaken.

MR. EDISON'S POSITION.

To the Editor of ELECTRICITY.

DEAR SIR: . . . Regarding the Electric School, I would say that Messrs. Barrett and Hornsby called on me before the School was started and outlined their plans, and as outlined I approved of the School. That is the only connection I have with it. Yours truly,

THOS. A. EDISON.

Orange, N. J., November 20, 1894.

VIEWS OF PROF. R. A. FESSENDEN.

To the Editor of ELECTRICITY.

DEAR SIR: Permit me, as a member of the electrical engineering profession, to thank you for your editorial on the National School of Electricity.

The fact that Mr. Hornsby has made misstatements as to the part taken by Mr. Tesla and others in the National School of Electricity is perhaps a matter which more concerns those who may have to do business with that gentleman than the general public. But the fact that he has endeavored to persuade men to join the course by holding out to them the prospect of salaries of from $30 to $50 per week, and of making immense fortunes by improving primary batteries, etc., is a matter which concerns the profession generally—and the police. There are men enough out of employment now without adding to their number or taking their money on swindling pretences.

There is a large field for a school such as the National School of Electricity started out to be. The general public do not as yet fully comprehend the uses and advantages of electricity, and their education in this matter cannot be taken up with any degree of success by colleges or technical schools. Could the eminent gentlemen whose names appear on the prospectus of the School get rid of the present management, the reorganized school would be in a position to confer an immense benefit on the electrical engineering profession throughout the country.

In the meantime every electrician will sympathize with those gentlemen whose willingness to aid in a necessary and philanthropic work has been taken advantage of by a management who appear to be intent on making money without the least regard to honesty.

I might add that, in a recent letter to a mutual friend, Prof. Thomas has stated that he has ceased to be actively connected with the School. I remain very truly yours,

REGINALD A. FESSENDEN.

Western University of Pennsylvania, Allegheny, Pa., November 17, 1894.

PROF. STINE'S OPINION.

To the Editor of ELECTRICITY.

DEAR SIR: Your favor of November 17 at hand. I have noted your remarks in the last issue of ELECTRICITY and beg that you will understand that I do not feel at all hurt at what was there stated.

It seems clear to me now that the promoter of the enterprise has used my name entirely without warrant. I have not the least blame to attach to you in this connection, but I feel delighted that I took pains to state my position fully in my last letter. I think that you have now put the matter before the country in such a light that the career of this School cannot be much prolonged. I am very truly yours,

W. M. STINE.

Armour Institute, Chicago, November 20.

MR. E. P. ROBERTS'S VIEWS.

To the Editor of ELECTRICITY.

DEAR SIR: Your editorial note in your issue of November 14, relative to whether there is a short-cut to knowledge, was of the character which commends itself to us. We regret to state that many of the inquirers who request information from us imagine that a few weeks of more or less hard study will make them electrical engineers, and become discouraged when they find that we insist upon first taking them through a course in mathematics, mechanical drawing and physics, and with an especially arduous training in the principles of mechanics, and that the study of electrical engineering will not be reached until from six months to a year has elapsed.

We believe that any system of education, *if honestly conducted*, is beneficial, but that there should be a correct representation as to what can be accomplished.

We do not advertise any "chromos," and we really do not see why we should be condemned because our school is "distinctly a commercial matter" any more than your paper should be condemned for such a state of affairs, and we trust that when next you have a representative in this city he will call on us and examine our methods. Yours truly,

E. P. ROBERTS.

Cleveland, O., November 20, 1894.

NOT WELL RECEIVED IN NEWARK.

(From the Newark Sunday Call.)

The Scheme for a School Here Abandoned.

Denounced as Misleading by an Authority.

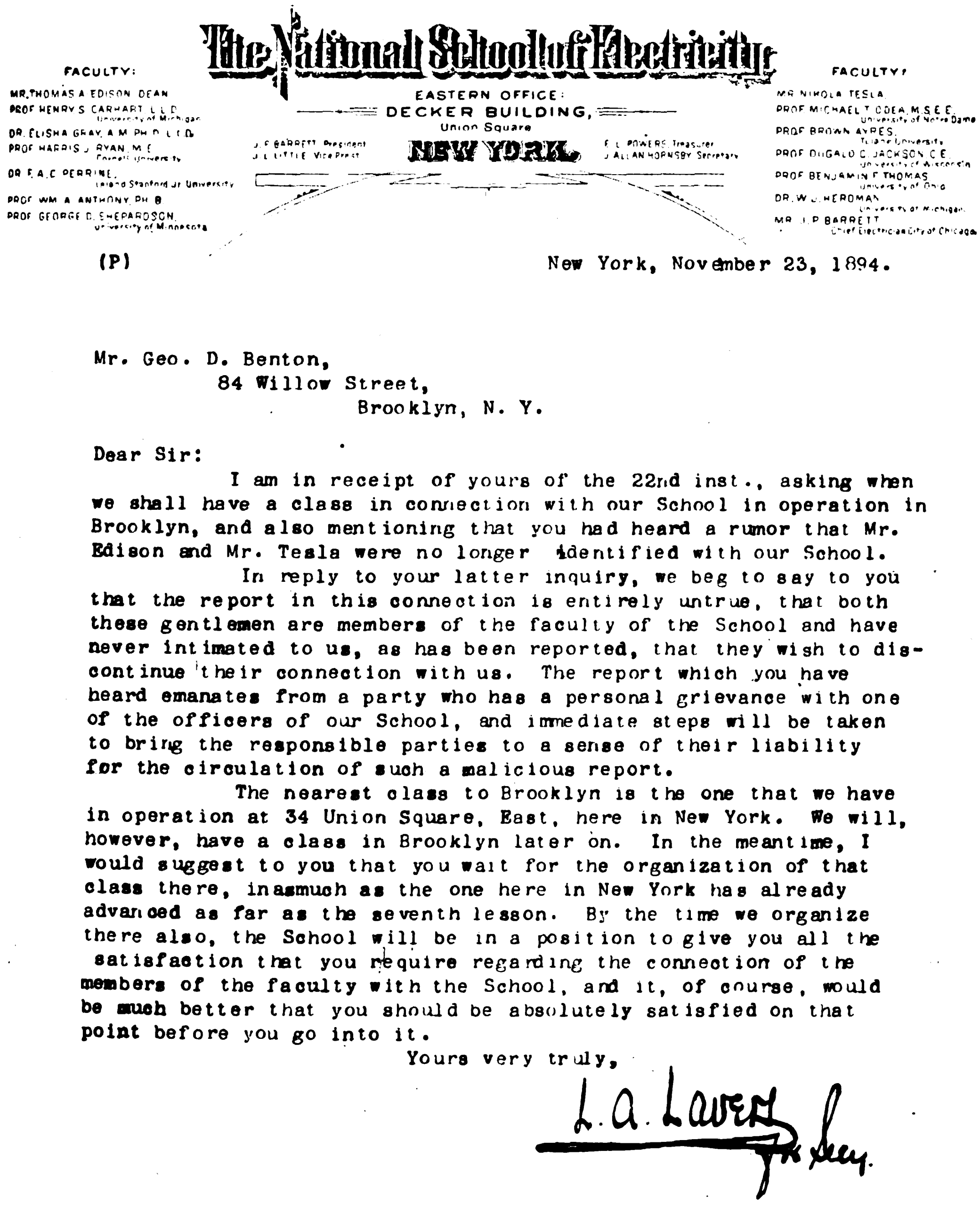
Two weeks ago last Friday night the preliminary steps were taken looking toward the formation of a class for instruction in elementary electricity in this city. A meeting was held and, although the attendance was not large, arrangements were made for another meeting, and the third meeting is set down for to-morrow night. Judging from what was gathered yesterday, however, the course of the new project for the instruction of young men in the elements of the all-important science of electricity does not promise to be entirely unruffled, for it has enemies, and enemies who have not been afraid to speak out their minds.

The plan to bring instruction in electricity within the reach of young men of moderate means is an excellent one, and when Prof. G. C. Sonn, of this city, was approached by a man interested in it last summer he expressed himself as heartily in favor of it. He was then asked if he would attend the first meeting and speak. He said he would, and the next he knew about the matter was that his name was on the printed circulars and he was announced as one of the speakers for the organization meeting. He attended this meeting but did not remain long, as he was not entirely satisfied that the project was to be conducted with a view to furthering the best interests of those who should join the class purely and solely. Louis Auerbacher, also of this city, and a practical electrician, was given to understand that his services as an instructor would be desired. He has since, it is said, decided to have nothing further to do with the movement.

But this is not all. ELECTRICITY, a weekly published in New York on Wednesdays, devotes its first page and half of the second to an arraignment of the National School of Electricity as follows. . . .

It has been learned that there was trouble in the class started not long ago by the National School in Harlem. The writer was informed that the class has decided to go on strike, as it were, until it receives what it considers satisfactory assurance that it is to receive the guaranteed return for the money it has already paid in.

The movement may be one of the best in the world, but it certainly has been unfortunate in its starting out.



The National School of Electricity

FACULTY:
MR. THOMAS A. EDISON DEAN
PROF HENRY S. CARHART LL.D. University of Michigan
DR. ELISHA GRAY, A.M. PH.D. LL.D.
PROF HARRIS J. RYAN, M.E. Cornell University
DR F. A. C. PERRINE, Leland Stanford Jr. University
PROF WM A. ANTHONY, PH B
PROF GEORGE D. SHEPARDSON, University of Minnesota

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PROF DUGALD C. JACKSON, C.E. University of Wisconsin
PROF BENJAMIN F. THOMAS University of Ohio
DR. W. J. HEROMAN University of Michigan
MR J. P. BARRETT Chief Electrician City of Chicago

(P)

New York, November 23, 1894.

Mr. Geo. D. Benton,
84 Willow Street,
Brooklyn, N. Y.

Dear Sir:

I am in receipt of yours of the 22nd inst., asking when we shall have a class in connection with our School in operation in Brooklyn, and also mentioning that you had heard a rumor that Mr. Edison and Mr. Tesla were no longer identified with our School.

In reply to your latter inquiry, we beg to say to you that the report in this connection is entirely untrue, that both these gentlemen are members of the faculty of the School and have never intimated to us, as has been reported, that they wish to discontinue their connection with us. The report which you have heard emanates from a party who has a personal grievance with one of the officers of our School, and immediate steps will be taken to bring the responsible parties to a sense of their liability for the circulation of such a malicious report.

The nearest class to Brooklyn is the one that we have in operation at 34 Union Square, East, here in New York. We will, however, have a class in Brooklyn later on. In the meantime, I would suggest to you that you wait for the organization of that class there, inasmuch as the one here in New York has already advanced as far as the seventh lesson. By the time we organize there also, the School will be in a position to give you all the satisfaction that you require regarding the connection of the members of the faculty with the School, and it, of course, would be much better that you should be absolutely satisfied on that point before you go into it.

Yours very truly,

L. A. Lavers Secy.

DR. CROMBIE THINKS IT'S ALL RIGHT.

Where Does the Responsibility Rest Now?

To the Editor of ELECTRICITY.

DEAR SIR: We received copies of November 14th issue of ELECTRICITY containing marked editorial on "Dr." J. Allen Hornsby and the National School of Electricity, in which you commend the course of the Pittsburg "boys" in appointing a committee to investigate "J. A. H." and the National School of Electricity.

The committee have tried to make an investigation sufficient to satisfy its members and those desiring to take the course that they will get their "money's worth."

As a result we have two letters from Prof. B. F. Thomas of Ohio University, assuring us that the School is all right, that two classes have been formed in Columbus which are doing good work under the instruction of two of his laboratory assistants, and that his own connection with the School is advisory.

We have two letters from Prof. H. S. Carhart of the University of Michigan, assuring us that the School is all right; that Edison and Tesla have not ignored it; that it does just what, in forming the class, was sought to be done; that his connection with the School is honorary and advisory.

We have before us at the present time two letters from Nikola Tesla to Mr. J. P. Barrett and the National School of Electricity about matters connected with the School, expressly stating that his name may be used, and heartily recommending the enterprise and wishing it success. Mr. Tesla's letters are dated March 22 and June 4.

In addition to the above we have a letter from a local school in Chicago stating that the course is all it claims to be and is giving satisfaction, and one to the same effect from a similar school in Fort Wayne, Ind.

The evidence cited has seemed to us sufficient to justify the organization of a class here if a satisfactory teacher can be obtained. Yours respectfully,

J. B. CROMBIE,
W. D. ROWAN, } Committee.
W. L. MCFREDERICK,

Allegheny, Pa.

[The above mentioned letters from Mr. Tesla were written before the School had attracted public notice. Mr. Tesla's position is exactly as stated in these columns. He has never given five minutes of his time to the work of the School, and never intended that his name should be used as an instructor. As to Prof. Thomas, his position is stated by Prof. Fessenden.—ED.]

STILL MAKING MISSTATEMENTS.

(From the Harrisburg Patriot.)

Professor Lavers Denies.

Says the Article in "Electricity" is Scurrilous and Libelous.

Dr. J. W. Roop, of this city, has received a letter from L. A. Lavers, of "the National School of Electricity," in which he makes emphatic denial of the statements printed in ELECTRICITY reflecting upon the character and motives of Secretary J. Allan Hornsby and other promoters of the School.

Professor Lavers insists that both Edison and Tesla are members of the faculty of the School, and declares that neither has ever made a contrary statement, as alleged by ELECTRICITY. Mr. Lavers says the editor of ELECTRICITY entertains a grudge against Dr. Hornsby and that this is the animus of the attacks of that journal.

[The editor who is handling this National School matter in these columns has never had five minutes' conversation with "Dr." Hornsby and has never had any personal controversy with him. Our animus is against the wrong, and not against the individual except as he is the agent of the wrong.—ED.]

Under the Searchlight.

Views and Opinions on Timely Topics.

No Experiments in Resuscitation This Year.

The Attorney-General of this State has given out his formal opinion that there is no authority vested in any official for allowing experiments in resuscitation to be made on criminals. The law seems to be clear that no one but the relatives of the condemned can grant this permission. But of what use would such permission be when the State authorities claim the previous right of having an autopsy?

Let there be a law passed early in January placing the necessary authority in the hands of some official, and let us have all the experiments possible, conducted by physicians of good repute.

* * *

An Envious Contemporary.

To envy because it goes well with another and goes badly with yourself is misery. Those who envy, pine in poverty; those who are envied, abound in wealth.—*Plautus.*

When any person of really eminent virtue becomes the object of envy, the clamor and abuse by which he is assailed are but the sign and accompaniment of his success in doing service to the public.—*Whately.*

Mr. Charles Pachyglossal Price cannot conceal the fit of shameful envy into which he was thrown when he learned that the publisher of ELECTRICITY had been the recipient of a necessary, though ornamental, article of wearing apparel—in short, a necktie—as a token of esteem from a few admiring and generous friends, while the publisher of the *Electrical Review* had received no such expressive testimonial; and he suggests, in his chagrin, that our publisher be strangled.

Wiser men than Brother Price have tried for over two years to find some way of strangling ELECTRICITY, but without avail.

You can't lose us, Charlie.

AN ELECTRO-MEDICAL FRAUD.

(Continued from page 232.)

dissected the apparatus, and reported as my opinion, substantially, that the instrument was entirely inactive; that in no way described, or suggested by the directions, nor in any other conceivable way would it generate or produce any appreciable force, electric or otherwise; and further, conceiving that there were to be by any means generated or present in the "polarizer," electricity of the highest potential practicable to be produced by thermal conditions, then that by no method of application described in the directions for use, or provided for in the apparatus itself, could there be any appreciable action or influence between the "polarizer" and the human body to which the "treating-plate" was applied.

My present opinion confirms the conclusions reached by the investigations of three years ago; and that is, that for any medicinal purpose in any way in which it can possibly be used the apparatus is absolutely inert and valueless.

Believing this to be true, I have watched with regret the increasing evidences of extension which this "enterprise" has put forth, and I was prepared to feel a personal gratification in your effort to throw light upon the character of the business.

You do not need to be reminded of the success of the *London Electrical Review* in stamping out fraudulent electro-medical business in England, but the complete triumph of that paper in a good cause is well worth your careful study. Yours truly,

JOHN A. BARRETT, Electrician.

New York, Nov. 26.

DENIAL FROM THE SMITHSONIAN INSTITUTION.

The following appeared as a Postscript in a part of our last week's edition:

At the time of our purchase of the Electropoise, Mr. Du Bois stated that the Smithsonian Institution had given the Electro-Libration Company a 12-page typewritten certificate stating that the Electropoise was a "scientific instrument of great value," and that either the Smithsonian Institution or Gen. Dyrenforth would furnish us with a copy.

We have received the following denial, which is conclusive:

S. P. LANGLEY, Secretary.
SMITHSONIAN INSTITUTION, WASHINGTON, D. C., NOV. 19, 1894.

MR. B. E. GREENE, Publisher of ELECTRICITY, New York.

DEAR SIR: The Secretary directs me to acknowledge the receipt of your letter of November 14, and to ask if you will be good enough to advise me under what circumstances it was reported that the Smithsonian Institution had given out a statement highly recommending the "electropoise" as a scientific instrument. Several inquiries of this kind have recently been made, seeming to indicate that some statement to this effect has been printed, and as it is entirely unauthorized, I am desirous of ascertaining how it originated, in order that the report may be contradicted, if necessary. The Smithsonian Institution gives no recommendations of this character. Very truly yours,

W. C. WINLOCK,
Assistant in Charge of Office.

We are now endeavoring to locate a copy of this alleged typewritten certificate and to make plain its fraudulent character.

NOTE.--Several other important communications on this subject are unavoidably held over till next week.

Inconsistency.

Some moral teachers of the press
  Seem much averse to others' teaching,
And writhe in evident distress
  When one condemns their mode of preaching.
These now with monumental gall,
  The right to criticise deny us,
Yet, spurning proof of fraud, they call
  Electropoise electro-pious.

The Toronto Boodle Matter.

The Brush Electric Company Scored.

They have been having a lively time in Toronto for several weeks investigating charges against certain boodle aldermen.

It was claimed that when the contract of the Toronto Electric Light Company was about to expire and the city contemplated building a municipal plant, Alderman Stewart approached Mr. Wright, the manager of the light company, with an offer to defeat the city plant scheme if he could have $13,000 for himself and four other aldermen; and that he offered, for the same consideration, to secure the city contract for the Brush Company.

An investigation has been held before Judge McDougall, who has made his report in full.

Mr. Wright and other citizens of Toronto appeared before the committee and told all they knew of the matter, clearly establishing their own innocence and convicting Alderman Stewart of the attempt to blackmail them.

The Brush Company's agents, Messrs. Wheeler and Rogers, did not appear, though strong effort was made to have them do so.

There is now a general suspicion in Toronto that these agents were not able to establish their entire innocence, and this view is confirmed by the ultimatum of the company that their men should not appear unless they had a previous guarantee that the Brush Company should get the contract.

Judge McDougall finds Mr. Stewart guilty, and expresses his opinion of the action of the Brush Company as follows:

I cannot refrain from commenting on the extraordinary conduct of the Brush Electric Company of Cleveland. It has been testified by both Mr. Keating, the city engineer, and by Mr. Bertram that the representatives of the Brush Electric Company had reported to them that corrupt approaches had been made to them by an alderman. These gentlemen in strong terms expressed their willingness to testify to these attempts to extort money from them. The correspondence, however, shows that there was an abrupt change of front. Mr. Rogers writes Mr. Wheeler not to go on the stand, and the company, by their subsequent correspondence with Mr. Nesbitt and Mr. Bertram, evidently are unwilling or afraid to give evidence of what they know concerning the alleged corrupt offers; they wish to make it a condition that if they give the evidence they shall get the contract. This proposition is almost as improper as the alleged corrupt approaches reported to have been made to the company. I draw attention to these facts in the hope that the company may yet see their way to send forward the witnesses in question when the inquiry resumes. Should they not do so such a decision on their part will tend to show that this company is willing to entertain corrupt approaches, because they now shield the alleged culprit or culprits. If their present attitude is persisted in, it should be a sufficient cause to effectually destroy any prospect they might have of becoming successful tenderers for any civic contract with an honest municipal corporation.

To Light Waste Places.

On Friday evening last the *Evening Post* had an interesting story, nearly a column in length, of an apparent attempt of the North River Electric Light Company, a G. E. concern, to secure a contract with the city for lighting vacant lots and streets not yet cut through in the Harlem district. The attempt was a failure, because suspicion was aroused by the great number of petitions presented for the lighting company. Controller Fitch's engineer made an examination and reported in brief as follows:

(1.) All the petitions were written on the same kind of paper and the wording of all of them was exactly the same.

(2.) All of the many hundred signatures of property-owners attached to the petitions were so much alike that they might have been written by one person or by persons who had made a study of imitating one another's handwriting.

The engineer says:

"It looks to me as if they (the petitions) were gotten up to secure some private interest, probably that of the electric light company."

Some of the alleged streets which it was proposed to light are not opened yet and have, therefore, no legal existence; others could be traversed only with the aid of a skilful guide, and others are lined with vacant lots.

Among those interested are Senator "Ed." Murphy, who rules by the grace of murder in Troy; Samuel Dana Greene, "Tony" Brady, Charles T. Hughes and E. H. Maher.

Personal.

Mr. Edward F. Austin, former sales agent of the Altoona Manufacturing Company for the Pittsburg district, has taken charge of the Pittsburg office of the Phœnix Iron Works Company of Meadville, Pa.

Mr. Addison G. Waterhouse, the well-known inventor of the Waterhouse arc lamp and arc system, who has recently returned from Europe, is now connected with the Mather Electric Company at their works at Manchester, Conn.

Mr. Charles Huntley, of the Buffalo G. E. Company, was a New York visitor last week.

Mr. Samuel Insull stopped over one night in this city last week, and has sailed for England to be absent two or three months.

Mr. J. Holt Gates has taken the Chicago agency for the Elwell-Parker Electric Company of America.

Prof. F. B. Badt, of the Siemens & Halske Company, who has been in New York for several days, returned home on Monday.

Mr. F. H. Clark, of the United States Electric Lighting Company, Washington, was a metropolitan visitor last week.

General News.

What is Going on in the Electrical World.

Nashua, N. H.—The Nashua Street Railway Company has asked the city council for permission to use electricity for motive power on its road.

Maplewood, N. J.—Meetings have been held here to discuss the question of establishing an electric road in this place, resulting in almost unanimous approval.

Elmira, N. Y.—The stockholders of the Waverly, Sayre and Athens line are said to be meditating the building of an electric road from Waverly to this city.

Kansas City, Mo.—The Metropolitan Railway Company intends to change its Broadway mule car line into an electric line if property owners and the council approve.

Lynchburg, Va.—The city council has settled the question of municipal lighting for the present by awarding a five years' contract to the Lynchburg Electric Company.

Philadelphia—The Hestonville and Mantua Passenger Railway will soon join the list of trolley lines. Sixty improved cars have been ordered from the St. Louis Car Company.

Mechanicville, N. Y.—The board of trustees have granted a franchise for the construction of an electric road between Mechanicville and Stillwater to the Powers brothers of Lansingburg.

Cuthbert, Ga.—Water bonds to the amount of $37,000 having been sold to N. W. Harris & Co., the waterworks and electric light plants will be constructed as soon as the plans are completed.

Shamokin, Pa.—The Shamokin Valley Telephone Company has been organized with a capital stock of $25,000, and a line will be constructed between Mt. Carmel, Shamokin and Sunbury in the near future.

Red Bank, N. J.—The board of commissioners have signed a contract with the Shore Electric Company for lighting the streets of this town with electricity for five years. The new company will furnish all-night lamps.

Newark, N. J.—The Newark Electric Match Company, a recently organized concern for the manufacture of matches, started their machinery a few days ago and are now in full operation with a capacity of 1,000 gross each week.

Salineville, O.—The Ohio and Pittsburg Coal Mining Company of Cleveland have contracted to equip their new Cedar Hill mine, south of Salineville, with electric mining machinery at an expenditure of $35,000.

Hightstown, N. J.—The borough council has passed resolutions recommending the adoption of water, sewerage and electric lighting systems, and to bond the town for $40,000. A special election will be ordered to sanction this action.

Rahway, N. J.—It is stated that the superintendent of the Rahway Horse Railroad Company is ready to put the trolley system in operation on the road if the city council will only remove the cloud which rests on the original franchise.

Mobile, Ala.—The signal office here has been authorized to substitute electric lights for the oil lamps now used in signalizing at night. As the electric lights can be seen far out in the bay they will prove of much benefit to mariners.

McGhee, Tenn.—Gen. Hamilton, of Ohio, manager of the Chilhowee slate quarries, is securing rights of way for an electric railway from McGhee station on the Knoxville Southern Railroad to the quarries and hopes to have the line built at an early day.

Coleraine, Mass.—C. A. Marcy, J. B. Clark and other influential citizens are interested in the proposed electric road between Coleraine and Shelburne Falls. It is proposed to use the water power at Franklin Mills to develop the power for propelling the cars.

Orange, N. J.—Notices have been posted to the effect that the Suburban Traction Company, which operates the electric line between here and Eagle Rock and Bloomfield, would be sold on Friday, the 30th inst., by the sheriff, to satisfy the claims of the creditors.

Dowagiac, Mich.—The Round Oak Stove Works here will soon use electricity as motive power. The dynamos will be located at a water-power five miles away, the current to be carried by heavy copper wires to the plant, where it will also be used as a commercial lighting circuit.

Asbury Park, N. J.—The Neptune Electric Company, which was organized twelve years ago to furnish light and power along this section of the New Jersey coast, has gone into the hands of a receiver. The liabilities are $67,000. The capital stock of the company was $200,000, of which $64,000 was paid in.

Seattle, Wash.—The Ranier Power and Railway Company and the Seattle Gas and Electric Company have been awarded the contract for lighting this city. Arc lights will be used as at present in the central and business districts and incandescent and gasoline lamps in the outlying sections.

Staten Island, N. Y.—As a result of the consolidation of the Prohibition Park and Port Richmond Trolley Company with the Midland Railway Company, the lines will be made electrical and a system will probably be instituted by which all parts of the island will be connected by trolley lines.

Williamsport, Pa.—The dynamos and electrical appliances to be used in carrying out the Beacon Electric Light Company's contract with the city have arrived and are being placed in position. The contract begins December 1, the date on which the Lycoming Electric Company's contract expires.

Toledo, O.—The statement is made that the Michigan Central Railroad Company purposes using electricity as a motive power. A test will shortly be made with the view of converting the entire system from Buffalo to Toledo via Detroit into an electric line, the power to be furnished from Niagara Falls.

Palmer, Mass.—It is apparent to many of our people that there is need of an electric road to connect Palmer with Monson, Three Rivers, Thorndike and Bondsville. Several prominent men in town are ready to take stock in the enterprise and the Palmer and Monson Electric Company agree to furnish power at a cheap rate.

New York.—The new Board of Electrical Control met on the 22d inst. in the Mayor's office and organized. The Mayor called the board to order. The new members—Amos J. Cummings, Henry S. Kearney and Jacob Hess—were all present. The Mayor was re-elected president of the board and Commissioner Kearney was made secretary.

Bucyrus, O.—J. G. Menser, of Galion, has applied to the county commissioners for a franchise to be granted to a new company to build an electric railway between Bucyrus and Galion, the work to be completed within a year. This is a rival company to the Bucyrus and Galion Suburban Electric Company, which already holds a franchise.

Corning, N. Y.—The Citizens' Electric Street Railway Company of Corning has been reorganized with a board of directors as follows: James A. Drake, F. D. Kingsbury, B. W. Wellington, John Magee and A. A. Houghton, all of Corning. It is the intention of this new board to push the street railway project as rapidly as possible.

Oberlin, Ohio.—A company with a capital stock of $100,000 has been formed to construct and operate an electric railway between Oberlin and Elyria. The principal stockholders are: Judge Steele, Albert H. Johnson and W. B. Bedortha, of Oberlin; W. B. Thompson, of Lorain; C. A. Metcalf, A. R. Webber, Hon. W. A. Braman and Parks Foster, of Elyria.

Springfield, Ill.—The accepted bids for the municipal electric lighting plant were as follows: Standard Electric Company of Chicago, $37,970, for electrical apparatus, pole line and construction; Buckeye Engine Company, $6,800, for three 160 H. P. engines and one 120 H. P. engine; Springfield Boiler Company, $8,180, for boilers, foundations, smokestacks, steam pipes and water connections.

Malvern, Ark.—The Electric Supply Company of Little Rock has agreed to establish an electric plant to supply this city with light. Malvern has now two new railroads in contemplation, namely the Pearla, Princeton and Southwestern and an extension of the Hot Springs to Helena. These roads when completed will open up some of the finest bodies of timber and agricultural lands in the South.

Hingham, Mass.—The Hingham Street Railway Company has asked the selectmen for a franchise, and the latter have the matter under consideration. The capital stock of $40,000 has been subscribed by residents. At a meeting of the selectmen, Mr. Hale, speaking in favor of the franchise, said that in reply to questions sent to 35 small cities and towns having electric railways 33 reported an increase in the valuation of real estate.

Canton, O.—A company has been organized, backed largely by Canton capital, to build an electric road from here to Akron. The road is to go by the way of East Akron, Krumroy, Greentown, Uniontown and New Berlin, while a branch will probably be run to Cottage Grove and Springfield Lake and the latter made into a summer resort. It is the intention to consolidate with the proposed line to Cleveland, making a direct line from Canton to the latter place.

Rutherford, N. J.—At a meeting of representatives of the Union Traction Company and the Newark, Rutherford and Hackensack Electric Railway Company it was agreed that the latter company should be absorbed by the former, Delos E. Culver and Henry H. Copeland becoming members of the directorate. Consents of property owners to the right of way through Lyndhurst, Kingsland and Rutherford are thus transferred to the Union Traction Company.

Boston.—Prof. Alex. Graham Bell, who has been on a visit to Washington, arrived in this city a few days ago on his way to Nova Scotia, where he now spends much of his time. He was interviewed while here and complained of the rigor of the agreement by which he disposed of all rights in his telephone invention, entailing as it does all future inventions and improvements on the telephone. He says he is now at work on the conservation of energy—a subject that there are no dollars or cents in. It is a purely scientific question. He spends the most of his spare time on it, but thus far has not accomplished anything definite.

Leadville, Col.—A party of Eastern capitalists who a few years ago had in contemplation the erection of an electric light and power plant here to run the mines and smelters, but gave up the scheme when the Populists came into power, have since the results of the recent election became known determined to carry out the project. The gentlemen interested are Governor Cleves, the newly-elected Governor of Maine; William Hanks, a capitalist of Vermont; W. W. Mason, a banker of Portland, Me., and Mr. Priddy, of Leadville.

Williamstown, Mass.—In connection with the projected electric railway between Williamstown and North Adams, citizens of North Adams have proposed that the site of old Fort Massachusetts be purchased and made into a public park, which would be accessible by the new road. Through the suggestions of Prof. Perry it is likely that a structure, somewhat similar to the old fort, could be built at a small expense. It was in the defence of this fort that the brave Ephraim Williams, founder of the college here, won glory.

London, Ont.—The Canadian General Electric Company report a larger amount of work now under contract than at any time since the formation of the company. They have at the present time contract work going on at the following places for the various classes of electric lighting plants: Thamesford, North Bay, Bracebridge, Kincardine, Preston, Galt, Sarnia, Mattawa, Collingwood, Summerside, P. E. I., St. Hyacinthe, Que., Sault Ste. Marie Canal, Almonte, Lethbridge, N. W. T., Keewatin and Victoria, B. C. Also street railway construction at Brantford, and railway power station work in Montreal and Toronto, covering the largest sizes of generators.

Brooklyn, N. Y.—The American District Telegraph Company at its annual meeting on the 19th declared a dividend of 2½ per cent. out of the surplus earnings. The following officers were elected: President, Tunis J. Powell; vice-president, David Barnett; secretary and treasurer, H. W. Kilbourne; executive committee: Clement Lockitt, George F. Gregory and Thos. F. Rockford; directors: H. D. Polhemus, David Barnett, George F. Gregory, Felix Campbell, M. N. Packard, W. M. Van Anden, Stephen Valentine, jr., A. B. Thorn, Thos. F. Rockford, J. W. Ridgway, Clement Lockitt, T. J. Powell, C. S. Dunning; inspectors: Henry Beam, W. B. Davenport, J. W. Carroll.

Savannah, Ga.—The plan of reorganization of the Electric Railway Company has been agreed upon and a committee appointed to carry it into effect. The committee consists of J. S. Collins, H. C. Cunningham, J. R. Anderson, W. H. Wilkinson, Jacob Paulsen, R. M. Hicks, W. J. Lindsay and W. D. Simkins. An agreement has been made with the Oglethorpe Savings and Trust Company to act as trustee for the purpose of making the exchange of securities provided for in the agreement. The plan provides for retiring all existing issues of bonds, and in lieu thereof to issue $600,000 5 per cent. first mortgage consolidated bonds upon the entire consolidated properties.

Chicago.—The *Tribune* refers to a scheme of extensive proportions which the people behind the General Railway Company are taking measures to carry out. "They propose," that paper says, "to ask the council for an ordinance granting them the right to construct electric railways on a large number of West Side and North Side streets. They contemplate the expenditure of some $10,000,000 in the building of electric lines, and they propose a system which will be no respecter of the territories heretofore set apart to the existing cable companies. A meeting of the stockholders of the company will be held November 26 to vote on the question of an issue of bonds to provide funds for the construction of the lines which the council will be asked to authorize. This bond issue will be for $10,000,000, with the Merchants' Loan and Trust Company as trustees."

Albany, N. Y.—The State Board of Railroad Commissioners have denied the application of the Amsterdam, Johnstown and Gloversville Railroad Company for authority to build its proposed road, on the ground that the existing roads are abundantly able to transact all business now offered or that is likely to be offered for many years to come. The commissioners say: "In different reports from the time of its organization this board has set forth certain evils that had been inflicted upon existing enterprises and upon the general community by the construction of unnecessary railroads. Such unnecessary railroads, after a brief period of unwholesome competition, had speedily gone into bankruptcy and had finally become a burden upon the older projects and upon the general community."—A project is on foot to unite Albany and Castleton with an electric railway for local trade.

The Van Vleck Service End Cut-Out.

MY DEAR MR. EDITOR: In your illustration and description of Mr. Van Vleck's "Service End Cut-Out" there appears "too much Johnson" and too little Van Vleck. I am not the father of that baby; my only relation to it in fact is a sort of cousinship, in that Mr. Van Vleck has married his invention to the Johnson Vise Lock Switch.

Kindly correct the injustice done to a worthy parent of a worthy child, and oblige yours truly,

EDWD. H. JOHNSON.

Repair Work in Philadelphia.

Messrs. Thompson & Allen, 1303-1307 Buttonwood street, Philadelphia, are meeting with pleasing success in their repair department. They employ none but mechanics who understand the business, and their work has proved satisfactory to all customers.

They also manufacture a standard line of arc-light supplies and do some business in second-hand dynamos.

INCORPORATIONS.

The Union Electric Company of Halstead, Susquehanna County, Pa., has been chartered at Harrisburg. Capital stock, $10,000.

The Citizens' Telephone Message Company, Monroe, Mich. Capital stock, $60,000. Incorporators: Harry W. Noble, Chas. E. Dorr, Winfield S. Warner.

The Shedlock Automatic Brake Company, Jersey City, N. J.—to manufacture and vend brakes for cars propelled by steam, cable, electric or horse power, etc. Capital stock, $250,000. Promoters: Alfred Shedlock, Jersey City; Wm. H. Foster, Elizabeth, N. J.; Anderson Price, Rutherford Park, N. J.

The National Electrical Reminder Company, Chicago, Ill.—to manufacture, sell and deal in electrical devices, appliances, instruments, etc., buy and sell patent rights. Capital stock, $250,000. Promoters: Siegfried Rosenfield, Augustus Rosenfield, David C. Thoms.

Wilder Sloss Electric Hotel Call Company, Chicago, Ill.—to manufacture, sell and deal in electrical devices and all articles pertaining to any electrical device. Capital stock, $250,000. Promoters: Louis Stein, Augustus Binswanger, Edmund R. Wilder.

The Moore Electrical Company—to manufacture electric lamp vibrator regulators and other electrical contrivances in New York City. Capital stock, $50,000. Directors: Joseph Livingston, Leopold Wallach, Daniel McFarlan Moore, of New York City, and Edward J. Wessels, of East Orange, N. J.

The Waupaca (Wis.) Electric Association has filed an amendment increasing its capital from $10,000 to $20,000.

The Chicago Electro-Therapy Company, Chicago, to maintain a hospital. Capital stock, $50,000. Incorporators: Charles S. Wood, Sarah V. Westrup and L. J. H. Wells.

The International Copper Smelting Company, Jersey City, N. J.—to smelt and refine copper ore and other metals in all branches by means of fire, electric, chemical or other processes, etc. Capital stock, $5,000. Promoters: Gen. Lowther, Riverside, Conn.; Edw. L. Smith, Francis M. Smith, Ansonia. Conn.; Thos. K. Egbert, Pattenberg, N.J; Chas. H. Brush, Henry J. Uderitz, Brooklyn, N. Y.

The United States Electro-Magnetic Company, Chicago, Ill.—to manufacture and sell chemical pads, etc. Capital stock, $250,000. Promoters: E. S. Lenert, Atlee V. Coale, A. M. Levy.

The International Beer Electrofying Company, Chicago, Ill.—to manufacture and sell beer made in accordance with the electrofying process, and manufacture and sell apparatus therefor. Capital stock, $100,000. Promoters: Paul Kropf, Jno. Henry Pank, August Gruell.

The Peru Electric Light and Power Company, Peru, Ind. Capital stock, $60,000. Promoters: Volney O. Irwin, Crawfordsville, Ind.; Paul E. Covington, Kansas City, Mo.; Nat. Covington, Peru.

The Carthage, Webb City, Joplin and Galena Electric Railway Company, St. Louis, Mo.—to build and operate a railway. Capital stock, $175,000. Promoters: Jno. J. Taussig, David R. Powell, St. Louis; Chas. C. Carroll, Springfield, Ill.

The Mount Carroll Electric Light Company, Mount Carroll, Ill.—to establish and operate an electric light and power plant. Capital stock, $12,800. Promoters: Owen P. Miles, Wm. Q. Sayers, Oscar F. McKenney.

The Montpelier Electric Light Company, Montpelier, Ind.—to supply electric light, heat and power. Capital stock, $15,000. Promoters: Jno. P. McGeath, Jno. A. Remy, Hartford City, Ind., Allen M. Nall, Kokomo, Ind.

The Union Telegraph and Telephone Company, Pittsfield, Mass.—to transmit intelligence by electricity. Capital stock, $5,000. Promoters: S. N. Fuller, Michael Casey, R. A. Burget.

The S. K. C. Specialty Company, Pittsfield, Mass.—to manufacture and sell machines, apparatus, tools, electrical appliances and novelties. Capital stock, $12,500. Promoters: R. de W. Sempson, Wm. Gardner, Jno. F. Kelly, C. C. Chesney.

The North American Interior Telephone Company of Baltimore City, Baltimore, Md.—to manufacture telephones, telephone appliances, electric appliances, electric switches and other electrical machinery. Capital stock, $60,000. Promoters: Fred'k W. Schulz, J. Kemp Bartlett, Jr., Seneca P. Broomal, Chas. C. Hughes, Thos. R. Brimner.

The Winchester Chemical Company of Chicago, Chicago, Ill.—to manufacture and sell medical preparations and electrical appliances. Capital stock, $20,000. Promoters: Joachim B. Weinrautb, Jos. Schensowsky, Harry A. Jackson.

The Whittingham Electric Car-Heating Company (incorporated in West Virginia), Baltimore, Md.—to manufacture electric appliances for heating electrical cars by means of the power used to propel the cars. Capital stock, $100,000. Incorporators: Percy B. McLaran, Alexander Brown and Henry W. Williams, of Baltimore, and Frank Della Torre and G. H. Whittingham, of Baltimore County.

The Mound City Electric Light and Power Company, Mound City, Ill. Capital stock, $50,000. Incorporators: A. J. Dougherty, E. G. Bruckman and S. E. Bruckman.

The Newton Electric Light Company, Newton, N. J. Capital stock, $25,000. Incorporators: Dr. Julius Skilton, Harry J. Skilton, A. J. Van Blarcom, Wm. H. Earl, John Huston, Henry Huston.

The Second Avenue Traction Company, Pittsburg, Pa. Capital stock, $10,000. Directors: G. T. Hamilton, of Edgewood; W. F. Ford, of Allegheny; W. I. White and T. D. Dierker, of Pittsburg. The Pittsburg *Leader* says the directors of this company are all "figureheads" and that the chartering of the company means the formation of a big combination between the present Second Avenue Passenger Railway and all the lines operating between Pittsburg and Braddock, McKeesport, Homestead, Wilmerding, etc. Among the companies said to be concerned in the consolidation are the McKeesport and Turtle Creek Street Railway, the McKeesport and Wilmerding, the McKeesport and Reynoldton Passenger Company, the Homestead Street Railway and another company projected to extend through Elizabeth.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED NOVEMBER 13-20, 1894.

ELECTRIC RAILROADS AND APPLIANCES.

528,949. Trolley. Benjamin F. Lare and Charles M. Greer, Philadelphia, Pa., assignors to the Ajax Metal Company, same place. Filed May 1, 1894.

528,959. Intersecting Electric-Railway Tracks. Mark Lowd, Salem, Mass. Filed Feb. 10, 1894.

528,963. Underground Conduit for Electric Roads. Ezra A. Mathers, Romeoville, Ill. Filed June 12, 1894.

529,058. Trolley-Wire Hanger. John M. Anderson, Boston, Mass., assignor of one-half to Albert Anderson, same place. Filed July 19, 1894.

529,354. Contact Device for Overhead Electric Railways. Josiah L. Blackwell, New York, N. Y., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Sept. 15, 1888.

529,552. Trolley-Stand. Frank N. Kelsey, New Haven, Conn., assignor of one-half to Charles L. Wright, same place. Filed Aug. 29, 1894.

529,616. Section-Insulator. Albert Hennefield, Christ. Dehner, and Charles H. Van Ness, Colorado Springs; Colo. Filed April 19, 1894.

529,671. Gearless Electric Locomotive. Charles J. Van Depoele, Lynn, Mass., C. A. Coffin and Albert Wahl, administrators of said Van Depoele, deceased, assignors to the Thomson-Houston Electric Company, Boston, Mass. Filed June 3, 1891. Renewed Sept. 17, 1894.

ELECTRIC LIGHTS AND APPLIANCES.

529,240. Electric-Arc Lamp. James Brockie, London, England. Filed June 19, 1894.

529,429. Electric Incandescent Lamp. Elihu Thomson, Swampscott, and Edwin W. Rice, Jr., Lynn, Mass., assignors to the Thomson-Houston Electric Company, of Connecticut. Filed Feb. 8, 1892.

529,451. Combination Gas and Electric Light Fixture. Gustav A. Loeben, Philadelphia, Pa., assignor of two-thirds to Charles Falkenstein and George Falkenstein, same place. Filed June 7, 1894.

529,532. Switching Apparatus for Incandescent Electric Lamps. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed April 23, 1889.

529,654. Electric-Light Fixture. John R. Konetshny, Brooklyn, assignor to the E. P. Gleason Manufacturing Company, New York, N. Y. Filed Feb. 21, 1894.

DYNAMOS, MOTORS, ETC.

528,924. Radiating and Supply System for Thermo-Electric Generators. Harry B. Cox, Hartford, Conn. Filed Feb. 27, 1893.

528,925. Electrical Transformer. Frank S. Culver, Eau Claire, Wis. Filed Dec. 19, 1893.

529,085. Electromagnetic Machine. Gordon J. Scott, Philadelphia, Pa., assignor of one-half to Albert H. Henderson, same place. Filed June 12, 1894.

529,117. Regulator for Dynamo-Electric Machines. Jules Ferrand, Darnetal, France. Filed July 3, 1891.

529,145. Dynamo-Electric Machine. Rene Thury, Geneva, Switzerland, assignor to the Compagnie de L'Industrie Electrique, same place. Filed Aug. 18, 1894.

529,182. Electrical Transformer. Fritz Zickermann, Berlin, Germany, assignor to Siemens & Halske, same place. Filed Dec. 9, 1892.

529,265. Means and Apparatus for Distributing Electricity. Haydn T. Harrison, London, England. Filed Jan. 19, 1894.

529,272. Alternating-Current Electrodynamic Machine. Maurice Hutin, Paris, and Maurice Leblanc, Le Raincy, assignors to the Societe Anonyme pour la Transmission de la Force par l'Electricite, Paris, France. Filed Aug. 20, 1892.

529,373. Electromagnetic Apparatus. Stephen D. Field, Stockbridge, assignor to the American Bell Telephone Company, Boston, Mass. Filed July 24, 1894.

529,385. Electric-Fan Motor. Frank X. Hofbauer, Newark, N. J., assignor, by mesne assignments, to the Armature Bell Company, same place. Filed Aug. 1, 1894.

529,437 Armature-Core. James J Wood, Fort Wayne, Ind. Filed Aug. 21, 1894.

529,461. Method of and Means for Synchronizing Alternating-Current Motors or Generators. Henry N. Potter, Allegheny, assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Filed May 3, 1894.

529,563. Apparatus for Generating Electricity for Lighting Railway-Cars. Thomas A. Murray, Boston, Mass. Filed May 3, 1894.

529,650. Continuous-Current Dynamo-Electric Machine. Maurice Hutin and Maurice Leblanc, Paris, France, assignors to the Societe Anonyme pour la Transmission de la Force par l'Electricite, same place. Filed Feb. 12, 1894.

TELEPHONE AND TELEGRAPH APPARATUS.

529,203. Telephone. John Serdinko, San Antonio, Tex., assignor to the National Union Telephone Company, same place. Filed April 28, 1894.

529,300. Autographic Telegraph. John O'Neil, New York, N. Y. Filed Nov. 27, 1893. Renewed Oct. 13, 1894.

529,465. Telephone System. John I. Sabin, San Francisco, Cal. Filed April 14, 1894.

529,484. Printing Telegraph. Bradley A. Fiske, U. S. Navy, assignor to the Western Union Telegraph Company, New York, N. Y. Filed Oct. 13, 1888.

529,609. Antiseptic Mouthpiece for Telephones. Rial N. Denison and Frank M. Geary, Brooklyn, N. Y. Filed April 25, 1894.

529,630. Printing-Telegraph. George A. Scott, London, England, assignor, by direct and mesne assignments, to the Western Union Telegraph Company, of New York. Filed Sept. 6, 1887.

SIGNALS AND SIGNALING APPARATUS.

529,059. Electrical Apparatus for Controlling Signals. Samuel S. Bogart, Schraalenburg, N. J., and Michael B. Leonard, Richmond, Va., assignors to the Electric Selector and Signal Company, of West Virginia. Filed Dec. 11, 1893.

529,165. Train-Operated Signaling System. Johann H. Frischen, Berlin, Germany, assignor to Siemens & Halske, same place. Filed Nov. 28, 1893.

ELECTRICAL MEASURING INSTRUMENTS.

529,433. Electrical Measuring Instrument for Switchboards. John Van Vleck, New York, N. Y. Filed April 14, 1894.

529,434. Electrical Measuring Instrument. Edward Weston, Newark, N. J. Filed Oct. 3, 1892.

529,435. Electrical Measuring Instrument. Edward Weston, Newark, N. J. Filed June 21, 1894.

SWITCHES, CUT-OUTS, ETC.

529,011. Electric Railway-Switch. Rollin A. Baldwin, South Norwalk, Conn., assignor to the Fitch Excelsior Switch Company of New Jersey. Filed Jan. 4, 1894.

529,164. Electric Switch for Railways. Charles M. Fitch, South Norwalk, Conn. Filed Nov. 18, 1893.

529,212. Automatic Electric Cut-Out. Daniel F. Sweet, Grand Rapids, Mich. Filed April 28, 1894.

529,213. Electrical Cut-Out. Daniel F. Sweet, Grand Rapids, Mich. Filed June 9, 1894.

529,363. Electric Switch or Cut-Out. John C. Cassidy, East Orange, N. J. Filed Aug. 11, 1894.

529,595. Electric Switch and Cut-Out. John C. Cassidy, East Orange, N. J. Filed Sept. 24, 1894.

529,421. Multiple-Switchboard System. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place Filed May 1, 1890.

MISCELLANEOUS.

528,960. Self-Winding Electric Clock. Adam Lungen, New York, N. Y., assignor of one-half to Robert Edwards, same place. Filed May 13, 1893.

529,000. Automatic Fire-Alarm System. Henry S. Tunnard, Rugby, and Arthur M. Keays, London, England. Filed Feb. 8, 1894.

529,019. Coin Controlled Phonograph. Frank S. Church, Detroit, Mich., assignor of one-half to W. Fitz-Hugh Edwards, same place. Filed May 12, 1892.

529,078. Process of Making Electrotype-Plates. John W. Naughton, New York, N. Y. Filed April 4, 1893.

529,127. Binding-Post for Electric Instruments. Ernest A. Lowe, New York, N. Y., assignor to himself and James Jones, Jr., same place. Filed Feb. 9, 1894.

529,144. Automatic Set-Back Annunciator. Henry C. Thomson and George J. Galbraith, Boston, Mass., assignors to the Electric Gas Lighting Company of Maine. Filed July 2, 1894.

529,199. Method of and Apparatus for Circulating Liquid Electrolytes. Paul Schoop, Zurich, Switzerland. Filed Dec. 29, 1893.

529,215. Method of Sheathing Electrical Conductors. Jas. Tatham, Philadelphia, Pa. Filed Jan. 2, 1894.

529,216. Conduit for Electric Conductors. James Tatham, Philadelphia, Pa. Filed March 17, 1894.

529,313. Electric Gas-Lighter. Charles G. Savage, Philadelphia, Pa., assignor of two-thirds to John L. Ricketts and Grant C. Osborne, same place. Filed June 13, 1894.

529,325. Electromagnet. Carl C. Gerlach, Cleveland, Ohio, assignor of one-half to Rudolph Gerlach, same place. Filed Dec. 9, 1893.

529,398. Audible Synchronism Indicator. Ralph D. Mershon, Pittsburg, Pa. Filed April 27, 1894.

529,399. Audible Synchronism Indicator. Ralph D. Mershon, Pittsburg, Pa. Filed April 27, 1894.

529,411. Manufacture of Electric Conductors. John Robinson, Philadelphia, Pa., assignor of one-half to William J. Channel, same place. Filed Feb. 16, 1894.

529,412. Insulated Electric Conductor. John Robinson, Philadelphia, Pa., assignor of one-half to William J. Channel, same place. Filed Feb. 17, 1894.

529,419. Manufacture of Electric Conductors. John Robinson, Philadelphia, Pa., assignor of one-half to William J. Channel, same place. Filed March 6, 1894.

529,488. Electrician's Combination Tool. Jacob M. Gile, Denver, Colo. Filed March 20, 1894.

529,559. Electric Circuit. Joseph W. Marsh, Pittsburg, Pa. Filed April 10, 1894.

529,666. Electrical Releasing Device for Target-Traps. Charles H. North, Cleveland, Ohio, assignor to Paul North, same place. Filed Aug. 16, 1894.

ELECTRICITY.

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WANTED.—The issue of "Electricity" for November 21 has been exhausted, and we will pay 10 cents per copy for any number which our friends will return to us.

EDITORIAL NOTES.

Subway Explosions and Their Remedy.

There seems to have been a return of the epidemic of subway explosions which have perennially attracted the attention of the public ever since the electric wires have been put underground. During the past week or two we have received word of the occurrence of these convulsions from abroad, from Brooklyn, Boston, Rochester and perhaps elsewhere, and so numerous are they becoming that everyone is asking himself, Where will it happen next? But what should concern us more are the causes of these explosions and their remedy. There has never been any question as to the cause—it is due to an accumulation of gas in the manholes and its ignition by a spark, electrical or otherwise. The remedy is also clear, viz., to so ventilate the subways as to prevent such accumulations of gas. So long as gas pipes are laid in our streets so long will they probably leak and the escaping gas find its way into the sewers, electrical conduits and other vacant spaces, where it only needs the torch in the form of a lighted match, a spark from a horse's shoe on a cobblestone, an electric spark, or from other source to become active in a most offensive way.

It has been recognized pretty generally that safety lay in proper ventilation; natural draught, by connecting the conduit systems to smokestacks and lamp-posts or by small iron pipes carried up the sides of neighboring buildings, and forced draught have been resorted to with indifferent success. As a matter of fact the proper ventilation of the conduits is an aggravated example of the problem of mine ventilation, and we should be able to learn something from the experience of the mining engineer as to its solution. In mining work it has been found utterly impossible to properly ventilate any extensive workings in gaseous territory either by natural draught or by forced draught, which, thus far, have been the only methods attempted in our conduits. Mining men have long since abandoned the attempt to keep the atmosphere in coal mines clear by forcing air down the shaft, and yet this is just what we are depending on for our conduits. The method which *has* proved effective has been to *exhaust* the air from the mine, and this is the method which should be adopted in our streets. There are other reasons—sanitary ones—why the forced draught now employed should be abandoned, in fact why it should be prohibited by the Health Department, viz., that it forces these accumulations of sewer and illuminating gases into every cellar that is connected with the street conduits. Even if the forced draught were more efficient than the exhaust, which mining men have so conclusively proved that it is not, it should give way to the exhaust for sanitary reasons alone, for by the latter method the sewer and other miasmatic gases of the streets will be removed from our cellars instead of being forced into them.

The present ineffectual methods of ventilation entail upon every user of electric current drawn from the subways the dangers, which are all the greater because unsuspected, of sewer and other miasmatic gases from the streets actually *forced* into their living apartments. The explosions are by far the less dangerous of the two. Let us remove both by a method that experience has proved effective, viz., by substituting exhaust for forced draught in our ventilation.

* * *

The Fight is Ended.

The Electric Storage Battery Co. of Philadelphia, makers of the chloride type of cell, are to be congratulated over the developments of the last few days, placing them in control of the storage battery situation in this country. For some time they have had the only commercial battery on the market here, and it is subject for general gratulation that they are now able to proceed with the development of the storage battery business without the annoyance of blackmailing patent litigation, or the so-called competition of disreputable rivals.

If the time, energy and money spent in the last eight years in storage battery fights had been spent in storage battery development, America would not now be so far behind Europe in this line.

The trouble has been partially that the licensees of the Brush Company could not see that the Brush patents did not contain all the possibilities of a successful battery, and that they assumed altogether too much in their treatment of the public.

For example, in the early days of these Brush patents the proprietor of the Maxwell House at Nashville, Tenn., purchased a storage battery plant of the Brush Company. It did not work satisfactorily. The lamps after a few hours' burning decreased rapidly in candle power. The agent who sold the plant advised the Brush Company of this fact, and suggested that they send an expert to see what was the matter. He received a telegram in reply from Mr. Stockley, substantially as follows: "The supposed decrease in C. P. is an optical illusion, as the voltage from these batteries remains absolutely constant until the last drop is consumed."

This telegram was shown to the proprietor of the house who replied:

"This theory may be correct; it may be an optical illusion; but I want this d—— d illusion removed at once. Get your —— batteries out of here and lose no time."

Electricity is convinced that Mr. W. W. Gibbs, and the other gentlemen now in control of the storage battery business of the country, will have no need to plead optical "illusions," and that American purchasers can now avail themselves of the highest type of battery in use anywhere in the world.

* * *

Pumping Coal Through Pipes. The brilliant humorist whose work illumines the editorial page of the London *Electrician* has been at it again. This time he has endeavored to have a little fun with our recent article on pumping coal through pipes, and, as happens too often, he has tackled a subject of which he is entirely ignorant, with the result that his fun is funnier than he supposed it would be. This is what he says:

> One of the most extraordinary and almost incredible schemes which has ever been put forward for the transmission of energy to a distance, is the idea of "pumping coal through pipes," which is said to be occupying the attention of Chicago capitalists, and which has without a doubt attracted the attention of a Chicago electrical contemporary. According to this paper, it is calmly proposed to grind coal to a fine powder at the collieries, then to mix it with an equal volume of water, then to transmit and distribute this gritty mud to various industrial centers, and finally to separate out the damaged fuel and burn it—as best they can! No doubt muddy water can be pumped through a pipe; there is nothing original in that; no doubt a 4-inch pipe will transmit 320 tons of this ruined coal per diem; nor can there be any denying that the grit can be ultimately separated from the water without appreciable loss in the tailings; but where the doubt does come in—if there is not absolute certainty to the contrary—is that the fuel will be worth anything more than the poorest and dampest smudge after it has been strained or allowed to settle in tanks. Of course, it would be possible to make block fuel, first of all evaporating out the abundant moisture—but no! the whole thing must be some one's huge joke, for they can do better than this in Chicago.

The scheme is not backed by Chicago capitalists and was not brought out by a Chicago journal; but a little error of 1,000 miles in locality does not count in the offices of our esteemed English contemporaries.

The article was printed in Electricity, 6 Park Place, New York, and the backer of the enterprise is Mr. Wallace C. Andrews, a conservative New York capitalist, whose invention of pipe lines for pumping oil made the success of the Standard Oil Company possible.

The whole matter long since passed the visionary stage. An experimental plant, pumping the mixture of 75 per cent coal and 25 per cent. water a considerable distance having settled the feasibility of this part of the scheme beyond question. And as to the value of the fuel, if Brother Trotter had read our article with more care, he would have found that higher authorities than he pronounce coal dust to rank next to natural gas in ease of combustion and in steaming properties. Indeed, if he were as well posted as he assumes to be, he would know that an experiment was made by one of the largest English iron works, twenty years ago, of burning this same fuel, coal dust, feeding it into the puddling furnaces by a blast, and that its high value was thoroughly proved. The puddling furnaces were ruined by the intense heat, and the method was abandoned, but from no fault of the fuel.

Within the next six months our contemporary will read of a coal pipe line in commercial operation a distance of 350 miles, from one of our bituminous coal fields to the seaboard, and we will take pains to send Brother Trotter data of its workings, as also of the economy in burning "the poorest and dampest smudge," which will not be damp at all, but thoroughly dried and purified.

* * *

The Power of Pelf. Soon after the appointment of Attorney-General Olney, Mr. F. P. Fish, former counsel of the Bell Telephone Company and now chief counsel of the General Electric Company, stated with positiveness that Mr. Olney's appointment was secured through the powerful influence exerted by the Bell people.

The importance of having their own man in that position is easily appreciated: in the suit to annul the Berliner patents they would have both sides of the case.

This unseemly boast of Mr. Fish's is now recalled by his recent utterances to personal friends in regard to the outcome of the Bate case, lately tried before the U. S. Supreme Court. He says there is no possible doubt but that the case will be decided in favor of the Bell Telephone and G. E. interests.

Does Mr. Fish know this? If so, how does he know it?

We shall see what we shall see.

* * *

There arrived in this country a few days ago a 10 H. P. single-phase alternating motor, adapted for use in connection with the type of machine in common use in this country. A public test will soon be made, and Electricity hopes to be able to report that there is at last a successful practical motor of this type on the market. That there is a wide field for such a motor does not need to be said.

The Welsbach Light. For some weeks Electricity has been making a thorough investigation of the Welsbach light, the claims of its promoters, its record in actual use, and its importance as a competitor of the electric light.

Some of the results of this investigation were embodied in our editorial last week, and the rest will follow in the next issue. Owing to the large number of calls received for help on this subject from Central Station men throughout the country we have decided to reprint all the matter in a small pamphlet, which will be issued about December 15, and supplied to Central Stations at a low charge for use in their various communities.

Orders may be sent in now. The price will not be over $20 per thousand.

Under the Searchlight.

Views and Opinions on Timely Topics.

> . . We are quite sure that our English contemporary has reference to a New York journal—one that had its beginning in Chicago, to be sure, but which was compelled to remove from this city owing to lack of support. This error has appeared in the *Electrician* before, and as it leads to confusion that is exceedingly distasteful to those actually engaged in electrical journalism in Chicago, we are constrained to request our contemporary to avoid its repetition.—*Western Electrician*.

We thank our juvenile contemporary for pointing out the fact that Electricity is not a Chicago journal. Our burdens are already heavy, and we do not desire to suffer any unmerited reproach.

But who are "those actually engaged in electrical journalism in Chicago"? If Chicago has an electrical journal, the news has not yet reached the metropolis.

* * *

An Ominous Number.

The "Cold Thirteen" was a term correctly used in Brooklyn for a long time, having reference to a block of the Board of Aldermen who always "got a price" before they would vote for any franchise. This same number of Aldermen has turned up in Syracuse, where they have refused a franchise to the Citizens' Electric Company. Aldermen from various American cities are now holding solitary sessions in the penitentiaries. The "Cold Thirteen" of Syracuse would better warm up.

* * *

The "Electrician" Directory.

The thirteenth edition of the London "Electrician Trades Directory and Handbook" will be out in January next.

The comprehensive character of this work is indispensable to anyone engaged in the business, and it is said the forthcoming volume will be better than any of its predecessors.

It is a lamentable fact, but it is a fact, that the American part of this directory furnishes a more accurate list of names and addresses than any of the so-called directories published on this side the water.

In addition, the electrical trade of the world is classified equally well.

* * *

Mr. Joseph H. Reall bobs up every now and then either as a philanthropist eager to give some valuable property to the public for a slight consideration or as an apostle of virtue. But Judge J. K. Rice, of New Brunswick, will need a defender of different caliber before he can upset the direct testimony of Mr. E. J. Wessels in the bribery investigation last week.

Electrical Carriages Fail to Beat Horses.

A Paris newspaper recently offered $2,000 in prizes for a long distance race of electrical road carriages.

Out of 102 entries there were 17 starters. The winner covered the distance from Paris to Rouen, 68 miles, in a little less than 11 hours, or at the rate of about 6 miles an hour.

A good pair of horses, if admitted to the contest, would have won this prize.

* * *

Perpetual Motion at Last.

Tesla, Edison and Moore Outdone.

(From the Greensburg, Pa., Democrat.)

Wm. Von Swartz, of West Latrobe has invented an electric motor that possesses many points of excellence and gives promise of becoming a great success. The motor has a capacity of 45 volts. The dynamo has a capacity of 100 volts and is capable of supplying 25 lights of 16-candle power each. One half of this power goes to the motor; the other half to the lights. The 45 volts which pass into the motor supply it with power and run it. Thus it will be seen it is a self-supplying machine. It does away with steam altogether. The machine, at present, must be started by mechanical power, which is ungeared as the dynamo generates sufficient electricity to supply the volts.

* * *

Complimentary to the Lynn Mechanics.

(From the Binghamton Herald.)

The General Electric Company recently cut the wages of its employees at Lynn, Mass., from 10 to 15 per cent., and there has been a rumor to the effect that there was to be a cut at the larger works at Schenectady. There is no reason why wages in that line of business should be cut. Electric works all over the country are crowded with orders and new men are in demand. It may be said to the credit of the company that they have given out through their manager at Schenectady that there will be no further cut and that the cut at Lynn was made only because they are not doing much work there and have only a few second-rate men who are now getting all they earn.

The Last Scheme.

Cataract General Electric to be Absorbed by G. E.

Is This the Little Joker Which Has Been Relied on to Win the Game?

Our best information is that a plan has been perfected whereby the G. E. Company is soon to absorb the Cataract General Electric Company on practically the same basis as that by which the Edison General, T.-H., and T.-H. International companies were taken into the original combine.

We cannot state positively that this plan will be carried out; we can state positively that it has received the approval of a majority of the boards of both companies.

The plan is to issue more G. E. stock in payment for the Cataract Company, and it is supposed there is enough mystery surrounding the value of the latter to permit of a subsequent boom in G. E. stock, and to allow the impairment of the capital to be wiped out in the next annual statement.

As we understand it, all the Cataract Company owns is the list of local franchises in the cities of Rochester, Syracuse, Utica and Albany, and the much advertised canal franchise from Buffalo to Albany.

There are untold possibilities in the scheme for humbugging the public and thimblerigging the stock market, but not a single possibility of honest benefit to anyone.

Personal.

Messrs. Henry Seligman, W. B. Putney and R. T. McDonald, who lately returned from New Orleans, report the condition of the McDonald railway properties there as being satisfactory in every respect. The syndicate owns 120 miles of track, and believe they have one of the best investments in the country.

An Electro-Medical Fraud—III.

ELECTROPOISE, GROSSEST OF THERAPEUTIC HUMBUGS.

The Position of the Religious Press.

> "The one discordant note in all this great display of genuine scientific and engineering work was found in the fact that in this same temple of science—in Electricity Building itself—naked imposture, quackery in the form of so-called electrical belts, hairbrushes, insoles and what not, had obtained a footing and stalked forth unabashed. No words of condemnation can be too strong to be applied to the parasites who, in the guise of healing and benefaction, succeed in extracting perhaps the last money from the sick and suffering for their worthless trumpery."—PROF. ELIHU THOMSON, in the *Engineering Magazine*.

In our last issue it gave us unqualified pleasure to retract our statement made in a previous issue that the *Sunday School Times* was one of the religious publications that had given space to the advertisement of the Electropoise. We had been loath to believe that a journal for which we had always entertained such a high respect should have lent itself to the propagation of such an imposition upon the unfortunate, and were only led into the error by the assurances of the editor of the *Christian Nation* that the bare fact (which he assured us was a fact) that the *Sunday School Times* had investigated the subject and had accepted the advertisement was enough to satisfy him of the propriety of accepting it. A later personal letter from Mr. Trumbull, the editor of the *Sunday School Times*, states that the advertisement *was* offered to them, but that upon investigation he became so well satisfied that it was a humbug that it was rejected. Mr. Trumbull was justly indignant at the accusation made, that his paper had in any way abetted such a fraud, and in his communication, which we published last week, he takes no little pride in the assertion that "the *Sunday School Times* rejected an advertisement of the Electropoise *before the members of the electrical profession seemed to be aware of its unsavory character.*" It thus seems that the fraud was so apparent that it did not require the special knowledge of an expert to detect it. This is exactly what we have maintained all along, and it places the other religious and literary journals in a most unenviable light that they should not have been able to see the same thing. It looks very much as if some of our moral and religious teachers were as readily blinded by the glare of gold as the irresponsible sheets which print everything that comes their way, regardless of character or intent to defraud only so long as they do not lay themselves liable to the law.

In the one place of all others where we should expect to find an entire absence of guile and deceit—in the organs of the church—we find imposture aided and abetted—and why? Simply because there is money in it. And what defence do they make for their course? One journal says, or its editor says: "I accepted the advertisement because the *Sunday School Times* investigated it and found it all right." Which, we are happy to state for the credit of that journal, is not true. "Because the woman tempted me" is a quotation as old as the human race, but a modern interpretation makes this read "devil" for "woman." Is this not a humiliating confession for a self-constituted exponent of truth and light to make? And then because the devil tempted him this same editor launches forth in his editorial columns in the choicest endorsement of the devil that he can find words to express. Let us quote a few of these which were made by an editor who confessed that he had made no investigation of the thing he endorses, but admitted the advertisement because, as he said, someone else who had investigated it thought well of it:

"We are not surprised that the announcement in the *Christian Nation*, October 31, of the Electropoise occasioned a widespread and profound interest. As the editor has gone about among his readers in this city and Brooklyn he has again and again been inquired of about it. . . . To be enabled to put ourselves into correspondence with the life-giving element of God's pure air seems to be so certainly the highway to health that they (viz., 'disappointed invalids who have suffered many things of many physicians, *spent their means*, and are no better, but rather worse,') are at once convinced that at last the real remedy is at hand. For *this* is precisely what the Electropoise does. . . . The writer's attention was first called to the Electropoise by the *candor* and *honesty* of the company's announcement of it. . . . We have the utmost faith in the efficacy of Electropoise . . . and wish to say personally to readers of the *Christian Nation* that they will find relief from its use. . . . We can freely join with others in the belief that it is destined to work more or less of a revolution in the art of healing, and do great good."—*The Christian Nation*, Nov. 28, 1894.

But Dr. Buckley of the *Christian Advocate* and Dr. Trumbull of the *Sunday School Times* say this thing is a fraud. How is this, Brother Pritchard?

In our last issue we called attention to one of the amusing incongruities that had arisen in the case of the *New York Observer*, which, on November 1, published nearly a column of editorial on "Doubtful Teaching About Healing," and in the same issue gave a quarter of a page to the advertisement of the Electropoise.

An even more amusing episode than this has developed during the past week.

In the advertising pamphlet issued by the Electro-Libration Company the very first testimonial is the following:

Testimonials.

The following is from Rev. W. H. De Puy, A. M., D. D., LL. D., editor of the *People's Cyclopedia* and several other well-known works, and now assistant editor of the *Christian Advocate* at New York, a position which he has filled for more than twenty years:

NEW YORK, Dec. 20, 1896.

Myself and family have received so much benefit from the use of your Electropoise, and I have become so thoroughly convinced of its practical value as a curative agent, that I feel warranted in commending it without reserve to the public. One of my friends, a widely known and highly esteemed clergyman and educator, after using the Electropoise for nearly two years in his family, said to me more than once, after thoroughly testing its merits, that if he could not get another he would not take a thousand dollars for it.

I cheerfully give you my permission to use this brief note in any way which may aid you in introducing the instrument to the attention of any community. Very truly yours,

W. H. DE PUY.

The outside back cover of the same pamphlet is entirely given over to an editorial which appeared in the *New York Observer* of February 22, 1894, referring to the undoubted merits of the Electropoise as certified to by the Rev. W. H. De Puy, A. M., D. D., LL. D., editor of the *Christian Advocate*.

Wherever the name of this gentleman, who by his title is a Master of Arts, Doctor of Divinity, Doctor of Laws as well as a Reverend, is mentioned, it is also mentioned that he is assistant editor of the *Christian Advocate*. On the strength of these announcements by the Electro-Libration Company we were led to include the *Christian Advocate* in the list of those who were deriving benefit from the exchequer of that company. The amusing part of it all is the receipt of the following letter which we reproduce—letter head and all:

J. M. BUCKLEY, D. D.,
Editor.
W. H. DE PUY, D. D.,
Assistant Editor.

Editorial Rooms of
THE CHRISTIAN ADVOCATE,
150 Fifth Ave., New York,
November 28th, 1894.

To the Editor of ELECTRICITY.

DEAR SIR: No doubt you are doing a very important work, but it would save you some humiliation if you would ascertain in every case before you send such a letter as that of November 20 to an editor whether your supposed facts are genuine.

We hereby inform you that the *Christian Advocate* did not publish that advertisement. It was offered to the paper, but, when shown by the advertising agent to the editor, it was rejected on the ground that it was a transparent humbug.

I hope you will take pains to give as much publicity to the correction of this mistake as you did to its statement.

Yours truly,

J. M. BUCKLEY.

It thus seems that there is a wicked partner in the joys and sorrows of the *Christian Advocate's* editorial staff. The wicked partner endorses most fully the Electropoise over his own name and is given the post of honor in the literature of the Electro-Libration Company, while the other pronounces it a "transparent humbug." The advertisement, it seems, was offered to this paper by its advertising agent, but as in the melodrama of the stage, virtue triumphed, and it was rejected. We congratulate the editor, Dr. Buckley, upon the stand he has taken, which goes far towards placing him in the right position before the public, but the fact is, nevertheless, that despite all his efforts thus far the name of his paper *is* being used to further the nefarious ends of the Electro-Libration Company. We have not yet heard from the *N. Y. Observer*, but it will doubtless endeavor to justify its own position in the matter by the same excuse offered by the editor of the *Christian Nation*, that "the devil tempted me."

But these two letters give us all the argument we desire to place the onus upon those who have accepted the fraudulent advertisements. The editor of one of the most highly respected religious papers in the world, who is most careful as to what appears in his columns, was justly indignant at the mere accusation that he had admitted such matter. He says he investigated the Electropoise and found out its unsavory character *before* the electrical fraternity had become aware of it. The editor of the *Christian Advocate*, another of our leading religious papers, investigated it and pronounced it a humbug. When such men as Drs. Trumbull and Buckley, at the head of two of our most conservative and influential religious papers, place themselves upon record in regard to the Electropoise as they have done, will not the editors of the other religious papers and of the literary magazines feel it incumbent upon themselves to look into the matter also? Will not the ministers of the Gospel, whose mouthpieces such papers are popularly supposed to be, feel it incumbent upon themselves to purge the church of this insidious taint? Of all the religious press, can the *Christian Advocate* longer afford to keep silence on this question?

Some of the religious press are in fact endeavoring to condone their conduct, and in one case, which for the present shall be nameless, have abused us for charging them with improper motives or conduct. To such, the following verse seems sufficiently apropos to warrant its repetition:

Inconsistency.

Some moral teachers of the press
  Seem much averse to others' teaching,
And writhe in evident distress
  When one condemns their mode of preaching.
These now with monumental gall,
  The right to criticise deny us,
Yet, spurning proof of fraud, they call
  Electropoise electro-pious.

Encouragement from the New York Health Department.

CHAS. G. WILSON,
Commissioner and President.
CYRUS EDSON, M. D.,
Commissioner.

HEALTH DEPARTMENT,
Center, Elm and Franklin Sts.,
(Criminal Court Building,)
New York, Dec. 1, 1894.

To the Editor of ELECTRICITY.

DEAR SIR: Your work is excellent and deserving of all praise. Yours truly,

CYRUS EDSON.

Highly Appreciated.

To the Editor of ELECTRICITY.

DEAR SIR: Having read in ELECTRICITY articles and letters regarding Electropoise, permit me to state, I take great pleasure in endorsing the letter of my professional brother, Dr. Henry H. Morton, dated November 24, 1894, upon that subject (published by you November 28, 1894). Feel assured that the "medical profession" will cheerfully aid in your meritorious endeavor to suppress "frauds" ("patented" or "pious"), and to educate the public for their benefit, "financially" or "otherwise."

Keep up the good work. Reward will come in time.
Sincerely yours, FRANCIS W. SHAIN, M. D.
117 Mercer street, Jersey City, N. J.

Another Feature of the Fraud Exposed.

A gentleman who called at the office of the Electro-Libration Company, December 3, to see Mr. Du Bois, was first informed that Mr. Du Bois was out of town. This gentleman then went out on the street for a moment, and another representative of ELECTRICITY was sent in to inquire for Mr. Du Bois. Meantime the gentleman first referred to had re-entered the office and sat there waiting. The latter was known to Mr. Du Bois, which probably explained his non-appearance, but when No. 2 sent in his card, Mr. Du Bois appeared, recognizing immediately No. 1 and greeting him cordially. No. 1 then, after some inquiries in regard to the "Electropoise," mentioned the testimonial from the Smithsonian Institution, which has been so widely advertised, and the existence of which has been denied in ELECTRICITY over the signature of one of the Smithsonian Institution officials. Mr. Du Bois was evidently embarrassed and said in substance: "Really this has been very humiliating to us, because we have found that the trusted agent whom we sent to Washington to procure the testimonial from the Smithsonian Institution misrepresented the case to us. He brought back what purported to be such a testimonial, but we have found upon investigation that he procured it by improper methods and that we have no right to use it. It was signed by Mr. William Hitchcock, who was formerly an expert in the employ of the Smithsonian Institution." It will be remembered by our readers that we referred to General Dyrenforth, of Washington, as having received $20,000 in the last two years, as stated by Mr. Du Bois, for legal services for the Electro-Libration Company. It is evident that General Dyrenforth still believes the Smithsonian Institution testimonial to be genuine, as will be seen from the following letter dated November 26:

To the Editor of ELECTRICITY.

DEAR SIR: I have your favor of November 14, and would say in reply that for some time I have had only one copy left of the report upon the thermo-electric action of the "Electropoise," which was made for me at the Smithsonian Institution, and that, in response to a request from Mr. Du Bois for a copy, I have been obliged to send the same to him. I am sure that he will be glad to show it to you or to anyone who may represent you if you will call at his office, 1122 Broadway, New York, or send there.

The paper which I have sent to Mr. Du Bois is a copy. The original was sent to Europe in relation to some matters there. It is to be returned to me soon. I can assure you, however, that the copy which Mr. Du Bois has now is, in every sense, an exact reproduction of the original. Very truly yours,

R. G. DYRENFORTH.

R. G. Dyrenforth, Counsellor at Law, Washington, Nov. 26, 1894.

We sympathize with Mr. Du Bois in his humiliating position, and assure him that before ELECTRICITY gets through with the Electro-Libration Company, with Mr. Du Bois and the Electropoise, every one of the fraudulent claims will stand on the same basis as that in regard to the letter from the Smithsonian Institution, and we shall be greatly surprised if Mr. Du Bois and his associate swindlers escape the penitentiary.

Dr. De Puy Is Still a Believer.

To the Editor of ELECTRICITY.

DEAR SIR: Referring to your inquiry, just now in hand, in which you ask, "Will you kindly advise us whether the testimonial which the Electro-Libration Company is using over your signature is authentic or otherwise," I hastily respond: that in December last I gave to Mr. John E. Du Bois, representing the Electro-Libration Company, a testimonial of which the following is a verbatim copy:

[*The testimonial is identical with the one above, signed W. H. De Puy.*]

This testimonial is "*authentic*," and is the only one I have thus far given to the public, though in response to many private inquiries I have strongly expressed *increasing confidence* in the use of the Electropoise as a curative, and also my belief (after extended personal acquaintance and inquiry) that the gentlemen representing the company in this city—Mr. John E. Du Bois and his associates—are persons of *conscience and incapable of practising a fraud upon the public.*

Your letter also encloses an article from the "New York Observer," in which you have marked the following quoted paragraph, apparently desiring your inquiry to cover it also: "The 'Observer's' representative sought an interview with Dr. De Puy, of the 'New York Christian Advocate.' This gentleman said, with no personal interest in the Electropoise save that inspired by the wonderful good it had done him, he gave the company the letter published in another column of the 'Observer.'" The "Observer" is correct. Its representative did call upon me and his report of the interview is substantially as given. Nothing was said about the views of papers or periodicals or their editors. The only question was my personal knowledge, and that of friends, of the merits of the Electropoise as a curative, and that was given.

Respectfully and truly yours,

W. H. DE PUY.

"Christian Advocate" Office, Dec. 3, 1894.

CURRENT ITEMS.

A method of electrical heating by which the temper of a harveyized armor plate at any given point can be drawn and made soft enough to permit the drilling of bolt holes without affecting the surrounding surface has been devised at the Homestead plant of the Carnegie Steel Company, and has been successfully tested at the Cramp shipyards. Before the method was introduced it was necessary to leave an entire strip six inches in width of the plate unhardened, rendering it at such points penetrable by projectiles.

Norton Bros., of Maywood, Ill., are using in their tin-plate factory an electric locomotive deriving its propelling power from a storage battery. The locomotive is 5 feet in length, 30 inches in width, and 44 inches in height. Its weight is about 5,000 lbs. The battery consists of 24 chloride cells, and is charged on the premises from a generator which is also used for supplying power to motors running machines in various portions of the plant. The locomotive has displaced hand labor in pulling small cars loaded with tin plate from one part of the factory to another. The plant consists of a number of detached buildings, and the magnitude of the operations compelled the adoption of some sort of mechanical power in transferring the heavy material between the several departments.

Mr. Patrick Doyle, C. E., editor and proprietor of *Indian Engineering*, is endeavoring to induce the companies which own the horse railways in Calcutta to adopt electric traction for city and suburban lines. He is also stirring up sentiment for a central station for incandescent lighting and power. It seems to us that there is a good field in India for the sale of American electric and ice-making machinery; much of the improved agricultural machinery used at the Government colleges and training schools is of American make, and the Anglo-Indians have exalted opinions of the practicability and usefulness of "Yankee notions."

A remarkable feature in connection with the lighting of Chamberz, a town near Lyons, is the height of the waterfalls from which water power furnishing 2,000 H. P. is taken. The falls on the Isere are eleven miles from the town and furnish a head of over 2,000 feet. The turbines drive seven 120 kilowatt alternators, the station pressure being 5,000 volts virtual. At the distributing points this pressure is reduced by sub-station transformers to 110 volts for supply. Another case in which water power is being used is near Fiume, in Austria, where 450 H. P. is taken from the Burrida, and the pressure is 3,000 volts, the current being used to drive mills at distances of two and one-half and six miles respectively.

Popular Electrical Science.

IV.

Light Without Heat.

BY NELSON W. PERRY, E. M.

In the previous number I endeavored by means of a water analogy to give a somewhat clear idea of how a variable electric current sets up wave undulations in the surrounding ether and how by means of these waves energy may be and is propagated through space from the conductor in which the varying current is flowing to any other conductors in space which may be acted upon by these etheric waves. I endeavored to make it clear that in this transference of energy no such thing as "flow" occurred but that the energy was *propagated* from one particle of water to another and not by the translation of the water from one place to another.

Now in the ether, as in water, there will be one wave for every change either in the direction or the intensity of the exciting current. If the changes in the latter follow each other very slowly, the waves which will go out into space will be far apart—they will be long, but not necessarily high. If the alternations follow each other very rapidly the waves which result will follow each other with equal rapidity, so that the limit to the frequency with which we can produce these waves is that of the frequency with which it is possible for us to change the direction of an electric current.

We all know that sound is produced by air waves, but all air waves do not produce sound. There is only a very limited range of air waves to which the ear can respond. If the air waves are too long, we hear nothing. If they are too short or follow each other in too rapid succession the ear is also unable to respond and so far as we are concerned there is utter silence. So with the ether waves. To the majority of them none of our senses respond, but throughout a very limited range they become sensible. When these ether waves follow each other so fast that 500,000,000,000,000 of them are thrown out every second, the eye is able to respond to them just as the ear does to sound waves, and we have the sensation of light. If the waves follow each other with less frequency than this the eye can no longer detect them and there is darkness, but we recognize those of lower frequency as heat. But for the vast majority of these waves, from the slowest up to the fastest we have no sense organ which will respond, and so far as we are concerned they pass by unheeded. But the fact that I wish most to impress is that the ether waves which we cannot discern at all by our sensations, those that we recognize by the sensation of warmth and those which excite the optic nerve with the sensation of light, differ from each other only in the frequency with which they follow one another.

If we excite these ether waves by means of heat, as for instance by heating a solid substance, we first set its molecules into vibration and these every time they vibrate send out little waves. As the heat increases the molecules vibrate faster and faster until they move so rapidly as to become faintly visible in the red hot condition of the solid. With greater rapidity the light becomes white, and then purple, and with still greater rapidity they lose their effect upon the eye and we no longer see them. We can, however, prove their presence by the action which they have upon certain chemicals, for they are extremely active chemically and are therefore called the chemical or actinic rays.

In our present methods of producing light, viz., by means of heat, we are compelled in order that we may get a comparatively few rays of sufficient rapidity to produce light to produce all of the other rays—from the slowest to the fastest also. It is just as though every time we wished to sound a very high note on an organ we were compelled to sound all of the other notes on the keyboard below it. It would require perhaps but a single stroke on the bellows to keep high C sounding for an hour or more, but if *all* of the notes below high C had to be sounded at the same time in order that we might get the one note we wanted the bellows would have to be pumped with the greatest vigor to get any sound at all.

Now, in our present methods of producing light, that is just what we have to do. We want a single note—the *light* note, which is high up on the scale, but the only way in which we can depress that key is by depressing all of the others below it. We expend an enormous amount of energy in producing the heat vibrations which we do not want, in order to obtain the comparatively few higher vibrations that will be useful to us in the form of light.

If we could find a way of touching the light key without sounding those below it, we would have a pure white light without heat. It would be a very cheap light also, for the reason I have tried to explain.

There are very few who have not given the matter some study who really realize how wasteful our present methods of artificial illumination are. According to Prof. Tyndall the useful or light waves given off from an ordinary gas flame constitute only $\frac{317}{1000}$ of *one per cent.* of the total number which the combustion of the flame gives rise to. In other words, we have to expend 99.683 per cent. of our energy in sounding the lower notes in order that we may be able to sound the one note—the only note that we want. To express it in still another way, to produce a single unit of light we have in the gas flame to expend over three hundred units uselessly. The incandescent lamp does considerably better than this, for it converts from 5 to 6 per cent. of the energy received into light.

But what would we think of a machine which took 100 horse power to run it and was only capable of doing 5 horse power of useful work? Yet that is the kind of a machine that the incandescent electric lamp is, and the gas flame is still worse, for when we expend upon it 100 horse power it only gives out $\frac{3}{10}$ of 1 horse power in the form of light. Our present method of production of light is therefore one of the most uneconomical methods of the transformation of energy made use of by man—and all because we cannot strike the single note we want without striking all the notes of the octaves below it at the same time. We know exactly where the key is, and we know full well that if we could but reach it and strike it alone we could produce a cold white light and produce over 300 lights at the same cost that now gives us but one. But how to reach the proper key is the problem which man has to solve. The firefly has solved it, but not man.

Mr. Tesla has produced etheric waves of a frequency of many millions per second, but even with this enormous frequency he falls far short of that required. He, however, believes that the grand object is attainable, and other scientific men agree with him in this. He has found another way of producing these etheric waves, and that is by what is known as electro-static action, and this constitutes his greatest discovery in the domain of optical physics. In speaking of this he says*:

"But powerful electro-static effects are a *sine qua non* of light production on the lines indicated by theory. Electro-magnetic effects are primarily unavailable, for the reason that to produce the required effects we would have to pass current impulses through a conductor which, long before the required frequency of the impulses could be reached, would cease to transmit them. On the other hand, electro-magnetic waves many times longer than those of light and producible by sudden discharge of a condenser could not be utilized. . . We could not affect by means of such (slow) waves the static molecular or atomic charges of a gas—cause them to vibrate and emit light. . . .

"It has occurred to me, however, that electrostatic effects are in many ways available for the production of light. For instance, we may place a body of some refractory material in a closed, and preferably more or less exhausted, globe, connect it to a source of high, rapidly alternating potential, causing the molecules of the gas to strike it many times a second at enormous speeds, and in this manner, with trillions of invisible hammers, pound it until it gets incandescent, or we may place a body in a very highly exhausted globe . . and by employing very high frequencies and potentials . . maintain it at any degree of incandescence, or we may, by means of such rapidly alternating high potentials, disturb the ether carried by the molecules of a gas or their static charges, causing them to vibrate and to emit light."

Here he announces three distinct methods of producing light, and he has produced it by all three methods and thus startled the world. These methods all involve heat, however, but so much less heat than ordinary methods that they constitute a long step toward the production of the ideal light without heat.

These discoveries set many other scientists to work in all parts of the world, and the solution of the problem now seems almost within our grasp.

It has been found that the so called phosphorescent bodies are excited into action so as to give light by electrical oscillations entirely too slow to produce light directly. Tesla made use of these, and found that by their use the light effects were considerably enhanced. This is now the most hopeful direction of investigation, viz., to find some highly phosphorescent substance in which we may be able by the electrical means at hand to excite the more rapid vibrations and thus bridge over the gap which still stands between us and the goal of our desires.

The latest contribution in this line, which however adds little to the knowledge which Tesla gave us on the subject beyond a simplification of the apparatus required, is by Mr. H. Ebert. He has made the result of his experiments known in the last volume of Wiedemann's *Annalen*, Vol. liii, p. 144. He uses as his luminous substance a button of the so-called luminous paint (calcium sulphide). This is enclosed in an exhausted glass globe. On the outside of this globe are pasted two circles of tinfoil to which connections are made to the generating apparatus. When the rapidly alternating electro-static charges are thus developed in these tinfoil strips on the outside of the globe they excite an intense phosphorescent action in the luminous paint button within and a phosphorescent light practically without heat is attained. This style of lamp he calls the "luminiscent" lamp, and of its performance the following is reported:

The candle power was found to be about $\frac{1}{30}$ to $\frac{1}{40}$ of the amyl acetate standard, which is approximately equal to the standard candle in this country. The energy expended, being difficult to measure directly, was calculated and found to be only about $\frac{1}{40}$ of that required to produce the same illumination in the amyl acetate standard.

Thus we have as an accomplished fact a light with the expenditure of but about $\frac{1}{10}$ of the heat ordinarily required. Perhaps the next step will be the discovery of some more suitable phosphorescent substance than calcium sulphide, which will respond more readily to the keynote we strike and give us in its higher harmonic our ideal light—light without heat.

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*Lecture before the American Institute of Electrical Engineers, May 20, 1891.

Conduit Electric Railways*—4.

Is There a Solution of the Problem?

BY JOSEPH SACHS.

DISCUSSION.—*Concluded.*

Mr. Sachs—I would like to ask Mr. Fairchild a question right here. Don't you think, Mr. Fairchild, that the construction adopted by the Metropolitan Traction Company and also by the Third Avenue Railroad Company is sufficiently strong to support any electrical car we have to-day?

Mr. Fairchild—I omitted to say that; I meant to say, excepting the Third Avenue and Broadway construction, they would seem to be strong enough for the electrical cars. But as you know, the electric traction is very much harder on the rails than cable traction where the headway is under three minutes. I know of but one road in this entire country, one that was equipped two years ago with electric traction, that has stood for two years any way decently. There is one road in Cleveland, built two years ago this month. I heard from the superintendent, in a very flattering letter, that it stood up very well; it has an eleven inch rail. I think the road in Cincinnati also has been standing well after completion of four years. It is in Cleveland, Ohio, that I considered the construction at the time the best in the country with the exception of Cincinnati; they are two of the best in this country. But you would be surprised to know the cost of keeping up electric traction, even where the rail is from 75 to 80 pounds, and where cars are not run very close together.

Now, I have got off from the Electric Conduit system. The serious point is the insulation, and to provide for the expansion and contraction of the conductor. I think there is nothing gained by the closed conduit or switching in and out. It is a question now whether the electric conduit is demanded, and if demanded, the point is the cost. I can only qualify it by saying that from my experience and observation I cannot see that the demand is very great for it.

The President—I would like to ask Mr. Fairchild if he has any figures as to the relative cost per mile, including the motor equipment; that is, of a cable car running on the ordinary speed or headway of 1½ or 2 minutes as compared with the electric railway. What would the rolling stock cost per mile of track?

Mr. Fairchild—Do you mean what would it cost per mile?

The President—What is the cost of a cable road as compared with that of an electric road? Every one knows that an electric car costs more than a cable car. What would be the difference in a mile of track assuming the same headway in both cases?

Mr. Fairchild—I am not prepared to state just now, Mr. President. I could give you figures later on; the cars in both cases will cost about the same; the grips cost all the way from $100 to $300; I think the Third Avenue grips cost $300. I don't know exactly what the motors cost; I should say at least ten or twelve times as much as the grips.

The President—A difference of about $1,000 per car?

Mr. Fairchild—Yes.

The President—We have with us this evening a gentleman who is identified with one of the conduit systems, one of the surface contact systems, that has attracted a great deal of attention and which is, I think, expected to attract further attention hereafter. As Mr. Sachs made some reference to it, I have no doubt that this gentleman will be glad to take up the thread, and make further reference to it at this meeting. I have reference to Mr. R. R. Lundell, who is well known to you all, and I hope we shall have the pleasure of hearing a few remarks from him.

Mr. Robert R. Lundell—Mr. President and gentlemen: I came here to listen and not to speak, but I shall say a few words in regard to the matter Mr. Sachs spoke of. It is a good scheme, as Mr. Sachs suggested, to operate by the three-wire system. But why cannot that be applied to an ordinary trolley road in this way between two trolley wires and use the ground as a neutral, thereby getting 500 volts between each wire and the track; that would save enormously in the cost of copper. We would use the same dynamos in our power station, simply coupling them as they are coupled in the three wire system.

The President—I want to state for Mr. Lundell's information that that system has been in operation in several places.

Mr. Sachs—I would also like to say that that particular system is being installed now by the General Electric Company, or will be hereafter, so I understand.

Mr. Lundell—Some reference was made to the system which we have been trying at 59th street, and Mr. Sachs stated it has been running. I want to state that it is running. We are running it to find out whether it develops any weaknesses, but we have not found any yet. We are ready to show it to anybody. As to the storage battery there, I do not believe everybody understands what service it is performing. With us we must have something to start those relays. We can do that in two ways, either with a small battery or we can start it mechanically. Of course, as soon as we have once got the current, if we do not accidentally miss it, we ought to go along all right. But the trouble is to make good contact on the contact rails, and therefore where you have a sectional rail we have found that it is exceedingly difficult to make a good contact. We may ride over a switch and lose the contact, and cannot go along in that case. Therefore it is necessary to carry a small battery to pick up after losing contact. To pick up you do not want amperes, but you need volts. We cannot pick it up unless we have volts. It won't go through the car wheels—it won't go between the car wheel and the track unless the rails are very bright indeed. The resistance otherwise will be so great that the electro-magnet does not respond. With the local source of electricity we can do away with a great deal of electric track construction which would make a complex system. We do away with the complications at switches and cross-overs. The storage battery is a very small one, but it carries the car through emergencies, and will even bring a car back to the station in case of break-down. Now, that battery is not used as an ordinary battery is used on storage battery roads. I want to call attention to the difference in this way. On the storage battery roads we expect one set of batteries to carry our car about twenty miles before it is re-charged again, and experience has shown that this is too much. There has not yet been any battery that could stand such a long run continuously. Now, we do not expect this battery to do any such great feats. We only expect it to carry us at the maximum ¼, ⅛ or 1/10 of a mile. So we are using a very small battery. Only one thing is necessary, and that is to get back again or pick up the magnet after losing contact. Fortunately we found such a battery, and the battery we are using does not weigh anything at all like the batteries such as storage battery cars usually have; consequently we do not call that any objection. The reason why Mr. Johnson and myself adopted this particular kind of system is this: the slotted conduit is all right provided it is built deep enough to suit the climate. In Europe we can get along with a fairly shallow conduit because the conditions are not so severe and the streets are in better condition. In Washington we ought to be able to get along with almost the same as they do in Europe, but in New York we need something extremely substantial and we need the conduits very deep and well drained. There is no question in my mind, if we take the conduit in 125th street, which I understand is very deep, that we can put the trolley wire in there and make a success of it. But the problem is to get a system for a city that is cheap enough, and that is the reason we abandoned the open-slot, because we thought the cost would necessarily be great, due to the enormous size of the conduit. We adopted the switching device which we have—I mean the electro-magnet—for the simple reason that the electro-magnet has shown itself to be positive. We have seen this in our telegraph instruments. We are ready now to put the system in for $30,000 per mile, double track, which is cheap enough.

Mr. Sachs—I would like to ask Mr. Lundell what is the voltage between the contact rail and the track, which I understand is the return.

Mr. Lundell—We average 300 volts. On the first experimental road we used 300 volts. If we increase the voltage we have necessarily got to have a better insulation. And I think that between 300 and 400 volts is all we ought to use in conduit construction.

Mr. Sachs—Another question. Does that $30,000 mean double track, ties, rails and everything complete?

Mr. Lundell—No. That means what we put in—the electric part; I failed to explain that. The cost of $30,000 simply includes the electric equipments, without rails or ties.

Mr. Sachs—In figuring the cost of a road and comparing it with cable or open conduit, it is necessary to go from the bottom up, for the reason that in the open-slot conduit when you figure the cost there you start right from the bottom and go up, and when you say $50,000 or $60,000 or more per mile, it means from the beginning to the end. I think, therefore, that the surface contact system or any system, or even the trolley, should be compared with the open-slot conduit in that way—we should start with the beginning, and consider rails, ties, and so forth, in the entire cost. But in my mind you cannot put down a good track for less than $10,000 per mile. Perhaps Mr. Fairchild can give us a better figure on that. Now then, simply add $10,000 for single tracks, or $20,000 for double tracks—add $20,000 to the $30,000 and you get $50,000 a mile. Then add the increased cost of each car equipment in the way of storage batteries, because the motor equipment is the same whether you use a single motor or a double motor. But there is another point there which I want to bring out and that is this: that the system I showed this evening, which was tried at Coney Island, gave me quite an experience with surface contact roads. Whether they have storage batteries or not does not enter in the problem. The point about it is this: it is a question of dollars and cents and how much current is lost by leakage. You find that on a road like the Broadway road or the Third Avenue road, where the cars run on very slight headway, your current would be going and you would not know where it went. The next question, and an important one, is simplicity and positive action. You can never get actual positive action and safety in any system in which there exists a large number of moving mechanisms located in the roadbed. No matter how positive they are, there is always the chance of uncertainty. It may be one in ten thousand or one in a million, but that one in the million may block your whole system.

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* Abstract of a lecture delivered before the New York Electrical Society, November 1.

Mr. Stetson—I would like to ask Mr. Lundell whether as a business matter he considers it good policy to carry around in his cars, at 5 cents for every 150 pounds, a large storage battery to provide for the connection and picking up when possibly that storage battery can be done away with. I think it would be very much cheaper to have a pair of horses to draw the car back than carry the batteries in cases where it is not necessary.

Mr. Lundell—We never call upon a storage battery except at the time we wish to use it. I find that by actual measurement with ten passengers in the car it makes but very little difference as far as the storage battery is concerned. The battery weighs only 1,500 pounds and takes care of itself. It is always sealed up and being charged continuously, and we never look at it.

The President—I would like to ask if Mr. Field would not give us a few words. He is an expert in electric traction.

Mr. C. J. Field—I did not intend to talk on this subject, but I have got warmed up as I listened. It has been my experience with street railway people that it is not a question of investment with them, but it is rather a question of where they are going to stand when they have spent their money. I find street railway people the most liberal I have had to do with in the electric business. You are meeting men who are spending millions and who are ready to spend it liberally provided they are getting a fair showing, that they are getting something for their money and can see where the dollars and cents will come in on their return. I would like to make a few suggestions on the comparative operation of cable and electric roads. I have been gratified to find that in the operation of street railroads in this country the electric shows a lower operation rate per car mile. In a good cable road the cost is in the neighborhood of two cents per car mile. We started a few years ago with electric roads at a cost of five or six cents per car mile, which, compared with our horse roads at ten and eleven, we thought very good. We have got down now to power stations furnishing power and charging in ordinary repairs in the vicinity of one cent per car mile. It is not generally known for the reason that so many street railway companies want to keep matters from the public. It has come down to even under one cent per car mile. But the fact remains that as we go along and see the difficulties we have to contend with, and as time goes on, I think where we have heavy traffic in certain conditions we have got to have a conduit. It is not going to compel the trolley to get out of the way any more than the trolley compels the horse-car roads to apply for electric franchises. It is going to raise difficulties with some of the companies that have a clause in their franchise compelling them to put in an electric conduit when a success. But treating it fairly and squarely, there are two cities in the country where it is going to put out the overhead trolley. I believe in overhead trolley; well built and well equipped, in certain cases, it is a thing of beauty and a joy forever. And such a road put in as it has been put in in some cities has cost a good many thousands of dollars per mile. Some of you might be surprised if I should say that in one city where I had the pleasure of establishing a system the cost of our system was up to $70,000 per mile for a single track. We had the pleasure there of paving the street from curb to curb. That was about $20,000, but that is of course an exceptional case. In regard to the different points of the conduit: The Siemens Halske conduit which was used at Budapest has been modified by the American managers in this country in some radical form which has not been spoken of to-night, and I know they have got their conduit in shape which would fill all the requirements of the American conditions. The conduit is a double one and plays between the two tracks, but each track is really a separate conduit, both of which however have a common yoke and manholes. I think the conduit which is going into New York here may be said to be a modification of the Siemens-Halske conduit. I understand the Siemens-Halske Company had the contract partly agreed upon and it came to the question of patents and they could not agree. On the question of closed conduits I think that of Messrs. Johnson and Lundell a good system. It has strong points of merit about it, and I think I can say it will perhaps be adopted for trial on some roads. The strong argument in favor of that form of conduit is that you have no uncertain element as you have with the open slot conduit. It is not a question of direct cost of the open conduit, but the question of clearing the right of way for the conduit structure, which can vary from 100 to 300 per cent. of the cost of the conduit itself. A closed conduit gets rid of this item of uncertainty. That uncertain item is one that is going to make a company hesitate in going ahead with any open-slot conduit system. The many pipes buried below the depth of the ties make this item very large sometimes. The voltage is also an important question. I believe in putting in enough copper because a little more copper does not cost so very much and we save in operation. On the question of the three wire system that is being tried in some cases overhead, I think that on a heavy system there is going to be a strong objection to it. Those of us who have had any experience with the Edison three wire system and keeping it in balance, I think will appreciate in a measure the difficulties of balancing a three wire railway system. And particularly if we divide it up between the two tracks as has been shown. I do not think any open conduit is going to be a success except with the double trolley wire. If we have a single trolley conduit we can easily get a short circuit between the wire and the structure. The saving in copper would not be so material in using a single wire when we consider the disadvantages. I do not know as I have any more notes on this subject.

The President—I want to say that we have with us this evening Mr. E. A. Merrill, and I know we should be all pleased to hear a few words from him.

Mr. E. A. Merrill—I have seen the three wire system in operation and I think the balancing is a great difficulty. Now, on the Bangor road they have a three wire system of distribution and frequently in going up steep hills on one side of their system they would have to take off the trolley and put it on the other wire. How much it is out of balance nobody knows. The same thing, I believe, was tried in Milwaukee. There they found the same question of balance. There they have water power and plenty of reserve and they did not notice it so much. I know a road, however, where they did notice it and had to abandon it. They also found a great deal of trouble with leakage. I would like to ask Mr. Lundell a question about his system, if the contact sections that were insulated were very far from each other? Now, I should think that under certain conditions of weather the insulation between two pieces of contact rails would be so low that there would be sufficient leakage to make the section connect with the rail under the car and in that way leave exposed a live section in a position to shock horses and people and make a very considerable amount of trouble. The question of copper, it seems to me, is another controlling item. The difference between 300 volts and 600 volts is in the ratio of 9 to 36, or four times. And it is not a very large road that puts in an investment of $100,000 to $150,000 in copper, and when you come to multiply that by four you are getting up very high, and the question of the amount of copper that is found necessary to give any results to-day is a very serious question.

Again, the storage batteries in the Johnson and Lundell systems is another one that presents many serious features. The question of weight itself does not seem to be a serious one, when you take it as to passengers, but when you come to add 1,500 to 2,000 pounds to the weight of the car you have added a considerable item. Another thing is that the batteries are used a very short part of the time. Current must be passing through them and they must be affected by the variation of the voltage which would occur along the road. This fluctuation of the voltage may at times give your batteries too much while at others the batteries may be feeding into the line. In either case the operation of the batteries under such conditions would perhaps be affected.

Mr. Lundell—The first question, about the leakage between rail and rail. That is a question which we thought of before, and we not only cut out the sectional rail from the line but we connect it to the ground. The distance is very short between rails. We are, however, going to use four feet space between for the reason that we will put a long brush underneath the car. We may just as well throw away that much sectional rail. As to the voltage, we run at 300 and sometimes it falls to 275, while the batteries practically are about 280. If we had an enormous battery then it would be true that the battery would actually feed into the line, but where we have a small battery it is not the case, the battery and line act together.

Mr. Fairchild—The statement made by Mr. Field, as I understood him, does not agree with my observations, and perhaps others understood him as I did. I understood him to say that electric and cable roads in certain conditions in some cases were operating at about the same cost per car mile. He referred only to power. As far as my observation goes, cable roads as a general thing under the same conditions operate cheaper than electric roads as a whole. That is referring only to power.

Mr. Field—I think I know of one road that has cable and electric cars both and the electric cars are showing on total expense almost the same as the cable and the expenditures are such that they are going to abandon their cable lines.

The President—I want to state with reference to the use of storage batteries, it being a subject with which I am somewhat familiar, that there might not be so much fear and trembling concerning the battery used in the Johnson and Lundell system as has been asserted this evening. I am familiar with most of the storage batteries. The storage battery as employed here may help you out under various conditions. But I do not wish to pronounce myself either in favor or against the surface contact system, because it is a matter I do not know enough about. Now, gentlemen, the hour is advancing, and if there is no other gentleman to take part in this discussion, I would ask Mr. Sachs to give us a few brief closing remarks.

Mr. Sachs—I have so many notes that I really do not know whether to begin at the beginning, at the end or at the middle, or run one way or the other. But I will take up Mr. Stetson's remarks first and discuss them. Mr. Stetson and Mr. Fairchild also have both compared the conduit construction to the cable. Mr. Field, on the other hand, has shown us that he, by actual experience, knows of roads, and has installed roads and operated roads in which the operating expenses are, that is, as far as power goes, less than the cable, and that the total expenses, including interest on capital invested and everything, are the same. Now, then, if the operation as regards the cost of power is the same the total operating expenses would certainly seem to me not to come above that of cable in an electric conduit system. Although our track equipment includes car equipment and would perhaps be higher with the electric system, still we must consider the power house, which is really the heart of the whole system, and as we well know, the power houses of the Metropolitan Traction Company and the Third Avenue road have not been inexpensive toys, mainly on account of their location and the immense cost of the machinery necessary; whereas with the electric system we might have gone up into the woods and burned anything we could find and get the same results.

I do not believe that the electric conduit railway will at all hurt the interests of the electric traction companies, and believe that both it and the trolleys have their own respective fields, separate and distinct from one another.

But the point I wanted to bring out, and I thought I did bring out, is that the conduit will be an expensive affair, and being expensive will be only used in the larger cities and by large corporations.

Now, in regard to the location of the insulator and wire, I believe it is much better to hang the insulator high and dry in the conduit than to support it from the sides or bottom. As regards underbearing contact and the expansion and contraction of the contact wire, I would say that if we used ordinary copper wire supported at intervals, even though it may sag between the insulators at one time of the year or be taut at another, the underbearing trolley will always push up against it and conform to the irregularities.

As regards surface leakage in the insulators, that can be done away with by having a long surface and also by having as few insulators as possible. The longer the surface the less leakage.

In regard to the gas in the conduit, I cannot say very much, because I have never seen the phenomenon in the way that Mr. Fairchild speaks of it.

Now, I would say in regard to the alternating system, I think that it is coming to the front, and I think that we can produce an alternating system of traction and at a low cost of copper by putting in the alternating current and using some form of gear, or by directly connecting the alternating current motor to the car axle in some way.

As regards the surface contact system, I want to answer Mr. Lundell that there is just this one point. In my operations with the system which I have described I have found something which is more important than the leakage and that is the uncertainty of the cutting in and out of the sections and the action of the switching devices. There is always the liability of leaving one of the sections alive. If it is not caused through leakage from that section which may be alive under the car it can be caused in several other ways, and it is a matter of possibility, in fact probability, that a section may be left in connection with the feeder, caused by the failure of a magnetic switch or relay to act. I think that even though this may be but a very slight possibility it becomes an element of the greatest danger on any road over which there is considerable traffic and which passes through a crowded thoroughfare.

Mr. Field brought out an excellent point, that where the conduit system is wanted it is not a question of cost. Something is wanted that is sure to operate after it is put in. We have not got an operative cheap conduit system, although the various surface contact systems are comparatively cheaper than the open-slot conduit, but I believe we can install an open-slot continuous wire conduit which, although quite expensive, will be operative.

As regards the uncertain element which Mr. Field spoke of, that is true in a great many cases, but in the construction which is being put down in Lenox avenue by the Metropolitan Traction Company they have practically a clear road. In either case it would be exactly the same with the cable or the electric conduit, between which, I think, we must make comparison.

In regard to the two wires, I believe that is unnecessary. I think we can use a single wire and structure by adopting the three wire distribution. I think in the form I have shown it, while it may not be perfectly balanced, still various devices can be arranged to keep the system in balance. I again want to make mention of the alternating current. Here we can get an extremely low voltage on the supply wires, from which the leakage occurs, while we can distribute the current economically at a very high tension; that in such a system where we can use 100 volts or so on supply wires we can certainly very readily use a single wire and the structure.

The storage battery as spoken of, in the surface contact system, I think, is simply adding another item of uncertainty and additional complication. The storage battery strong enough to pick up the magnet is used and has been used by myself and by many before me. I do not see where the necessity comes in of putting in a large storage battery, weighing 1,500 pounds or over, for the purpose spoken of. I think if we want to use a storage battery we should simply have it strong enough to pick up the magnet after the contact is lost.

I do not mean to say that the surface contact system cannot and will not work, because I believe with an exceedingly low voltage a system may perhaps be devised which would be operative under certain conditions, but I believe that that system must be absolutely simple and be free from the many small mechanisms which are inherent in the electro-magnetic class to which Messrs. Johnson and Lundell's systems belong. I think that a much simpler cutting out mechanism can be devised, and as an example of a simple system of cutting in and out the sectional contact I would again like to make reference to the Lineff and similar systems which I have shown this evening.

The alternating system here also presents various features. I believe that success may possibly be attained by the use of an alternating current reduced to a very low voltage at the surface contact and by the adoption of some exceedingly simple and absolutely positive method of cutting in and out the sections. But even then such systems would not be generally applicable and I believe that a perfect and operative system of this kind will be but very little cheaper than an open-slot conduit under the same conditions.

In closing, I would like to say, and I think there are many who will agree with me in saying that an open-slot conduit system can be designed and operated, but that it is simply a question with those who are to put up the money. From what I can see I think this item is the principal one which has prevented and still prevents the installation of a conduit system.

(*Concluded.*)

"In India," says *All the Year Round*, "the intrusion of snakes into dwellings has been prevented by laying two wires before the doors and around the house, which are connected with an induction apparatus. When a snake proceeds to crawl over the wires he makes contact and receives a shock which either kills him or effectually scares him. In a somewhat similar way, delicate wire netting, attached to a battery, is used to ward off the attacks of that terror of the night in hot climates—the mosquito."

The Chemical Theory of Accumulators*—V.

BY E. J. WADE.

As regards the negative electrode, it is almost invariably assumed that only normal sulphate is produced during discharge, and yet it is here more especially that such an action is most difficult to understand, for, troublesome as it may be to oxidize lead sulphate, it is many times more troublesome to reduce it, except in almost infinitesimal quantities.

M. Darrieus has indeed recognized this difficulty, and endeavored to explain it by propounding the theory that the formation of sulphate at the negative electrode takes place in two stages. First, suboxide of lead (Pb^2O) is formed presumably at the expense of the water in the electrolyte—and then this substance is acted upon by the acid, and converted into a mixture of normal lead sulphate and metallic lead, the latter serving as a nucleus to the former and not being further attacked; but such an explanation does not really advance matters any further than the simpler one given above, which assumes a direct formation of lead sulphate round a metallic nucleus.

Although such a suggestion does not before appear to have been made, nor, indeed, such a compound isolated, yet it would be a real help in this connection to assume the formation of a sub-sulphate of lead (Pb^2SO^4) corresponding to the sub-oxide Pb^2O. This latter substance is with difficulty distinguished from a mixture of monoxide and metallic lead (in fact, it is described as such in some text-books) when under the action of chemical re-agents; and, in the same way, the sub-sulphate would act like a mixture of normal sulphate and metallic lead when subjected to analysis. It would, too, in all probability, have a considerable conductivity and, therefore, be easily reduced on charging, while its color would no doubt be some shade of gray. "Sulphating" would consist in the conversion of a molecule of sub-sulphate into two molecules of normal sulphate,

$$Pb^2SO^4 + SO^4 = 2PbSO^4,$$

and only when this had taken place would it be possible for that formation of peroxide to begin which causes such a rapid drop of E. M. F.

Particulars are given in Prof. Ayrton's paper as to the variations in hardness of the active material during discharge, and it will be found that while the positive paste became exceedingly hard that at the negative gradually became softer, a fact which does not seem compatible with the formation of one and the same compound, i. e., normal lead sulphate, at both electrodes, but rather favors the theories just given.

The reactions that occur when charging secondary cells must necessarily depend on those of discharge, the one being the reverse of the other so far as the ultimate products are concerned; that is to say, if lead and peroxide are both converted into lead sulphate on discharge, on charge lead sulphate is converted back to lead and lead peroxide; if only lead monoxide is produced on discharge, then the charging reactions will be similarly modified. The same thing holds good of the electrolyte. If on discharge hydrogen sulphate is absorbed and water eliminated, water must be absorbed and hydrogen sulphate eliminated when charging. In any case the cycle of changes must be such that the cell is restored to exactly the same state on its completion as at its commencement; for the cumulative effect of any reactions not complying with this condition will ultimately destroy the reversibility of the cell altogether, and, as a matter of fact, these do in practice determine its efficiency and life.

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*From "The Electrician," London.

In the third article of this series it was stated that if the chemical reactions when charging were exactly the reverse of those occurring when discharging, then the back or counter E. M. F. in the former case would be exactly the same as the E. M. F. generated in the latter case. Now, in practice this never happens. Even after full allowance has been made for the internal resistance of the cell, the charging E. M. F. is always higher than the discharging E. M. F. by some considerable amount. As a typical case to illustrate this point the curves given in Fig. 2 have been constructed from data furnished by Prof. Ayrton in his Paper on the "Working Efficiency of Secondary Cells." Curve *b* shows the variation of E. M. F. of a cell while discharging, expressed in relation to the ampere-hours *contained in the cell*, the point at which the discharge is stopped being arbitrarily assumed to correspond to emptiness. It is really, therefore, the ordinary discharge curve of E. M. F. (which is expressed in terms of the ampere-hours *given out from the cell*) but *plotted backwards; a* is a similar charging curve, and is of the usual well-known form, for in this case, on the assumption made above, the ampere-hours *put into the cell* and the ampere-hours *contained in the cell* are one and the same thing. By plotting the two curves in this way, so that points in the same vertical line correspond to similar conditions of the cell, as regards the ampere-hours it contains, in both operations, a very interesting comparison may be made between them, and one which brings out relations to each other that might not otherwise be noticed.

It will be observed that for approximately the first two-thirds of the charge, the E. M. F. is higher than that of the corresponding periods of discharge by practically a constant amount—in this instance nearly 0·14 volt; but that from this point onwards the difference between them continually increases until the cell is quite full, and even after that the E. M. F. still continues to rise. The only attempt to explain the high E. M. F. of the cell when charging appears to have been that of Messrs. Gladstone and Hibbert, who ascribe it entirely to the local strengthening of the acid in and around both electrodes consequent upon the reduction of the lead sulphate they contain. This theory, though extremely plausible, is hardly consistent with the whole facts of the case. If it were correct, then the local weakening of the acid on discharge ought to be equally marked provided the current in both cases is the same, and the accompanying E. M. F. as much too low as the other is too high. Instead of this it will always be found that throughout the greater portion of the discharge the E. M. F. is but very slightly below what is required to correspond to the strength of acid indicated by a hydrometer inserted in the main body of the liquid. This may be readily seen by reference to the discharge curve *b* (Fig. 2). At the commencement, when only six ampere-hours have been taken from the cell, its E. M. F. is 2·04 volts, which corresponds to acid of specific gravity 1·205 (see Fig. 1, article No. 4); while towards the end, when only ten ampere-hours remain in the cell, its E. M. F. is two volts, corresponding to acid of specific gravity 1·165, and these figures are approximately the same as those actually observed. If the same points are taken on the charging curve, it will be found that the E. M. F. at one of them is 2·13 volts, corresponding to acid of specific gravity 1·300, and at the other 2.22 volts, corresponding to acid of specific gravity 1·400—values far above that ever attained by the bulk of the acid.

Besides this, the experiments of Messrs. Duncan and Wiegand have proved conclusively that diffusion from the interior of the electrodes takes place most easily and rapidly when a cell is fully charged, and becomes more and more impeded as the charge is withdrawn, owing to the clogging up of the pores of the active material with lead sulphate. It follows, therefore, that if the difference between the E. M. F.'s of charge and discharge were caused by imperfect diffusion, it would be greatest when a cell was empty, and least when full; whereas a reference to Fig. 2 will show that exactly the opposite is the case.

The most conclusive proof, however, that the high charging E. M. F. cannot be ascribed to the rapid accumulation in the electrodes of the sulphuric acid liberated by their reduction, lies in the fact that the same phenomena occurs to an equally marked extent in a form of secondary cell in which the electrodes are perfectly solid and not in any way acted upon by the electrolyte—namely, Groves' gas cell. The theoretical E. M. F., according to Thomson's law, due to the combination of oxygen and hydrogen is 1·48 volts, and the E. M. F. of these cells when discharging is always below this value; but, nevertheless, the E. M. F. of the cell when charging may be forced up as high as 3·5 volts by sufficiently increasing the current density.

To say that this is merely the ordinary well-known polarization effect always observed when dilute sulphuric acid is decomposed with platinum electrodes explains nothing, although it is the usual way of meeting the difficulty. The laws of thermo-chemistry still demand that appropriate chemical reactions must be taking place, otherwise this high E. M. F. would not exist, and to discover what these are requires a consideration of the electrolysis of dilute sulphuric acid in some little detail. It is generally assumed that the acid breaks up under the action of the current into hydrogen (H^2) at the negative, and sulphion (SO^4) at the positive electrode. According to modern views of electrolysis, some portion of the hydrogen sulphate in solution already exists in a dissociated form as free molecules of H^2 and SO^4, which are attracted to either electrode as soon as a difference of potential is set up between them, their place being at once taken by others; so that, if this assumption is correct, the water plays no direct part in the process, but merely serves as a solvent and a medium in which dissociation can take place.

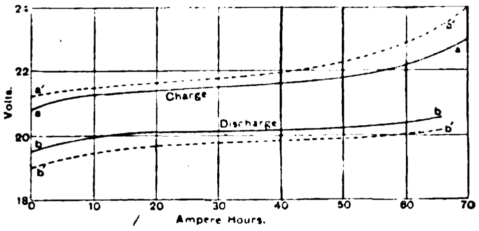

FIG. 2.

The hydrogen passes off at the negative electrode; but the sulphion cannot exist in a free state, nor can it in the case under consideration enter into combination with the substance of the positive electrode. According to earlier notions, it reacted with the water present, reforming hydrogen sulphate with the liberation of oxygen.

$$SO^4 + H^2O = SO^4H^2 + O.$$

In 1878, however, Berthelot discovered persulphuric acid [$H^2(SO^4)^2$], and showed that it was the primary product at the positive electrode when dilute normal sulphuric acid was subjected to electrolysis. According to this theory, the free sulphion combines with sulphuric acid instead of with water, thus—

$$H^2SO^4 + SO^4 = H^2\,(SO^4)^2,$$

and it is this reaction that is the cause of the high E. M. F. required to produce the decomposition, for persulphuric acid is one of those comparatively rare compounds, termed "exothermic," whose formation is accompanied by an *absorption* of energy, and which *liberate* energy on decomposition. The compound is, however, an exceedingly unstable one at ordinary temperatures, and the bulk of it immediately undergoes decomposition at the electrode, reacting with the water and passing back to the normal acid with the liberation of oxygen.

$$H^2(SO^4)^2 + H^2O = 2H^2SO^4 + O.$$

This reaction, no doubt, forms part of the electrolytic series, and the energy liberated is restored to the circuit; but the small percentage of the acid that diffuses into the electrolyte, and there undergoes a more gradual decomposition, gives up its energy in the form of heat. In this case, however, the decomposition is not such a complete one, and generally takes place in two stages, hydrogen peroxide being the intermediate product, and afterwards breaking up into water and oxygen.

$$H^2(SO^4)^2 + 2H^2O = 2H^2SO^4 + H^2O^2,$$
$$H^2O^2 = H^2O + O.$$

(*To be continued.*)

Symbols and Abbreviations.*

Referring to the letter which we reproduced in our last issue, from the *Electrical World*, we should like to offer some remarks. The writer says that one of the fundamental principles (by the way, we have never yet seen any authoritative enunciation of these so-called principles) of the Congress system is "to use script or oblique letters as symbols for quantities and perpendicular letters for the names of units or their abbreviations." Now, script letters such as those shown both in the *Electrical World* and in this paper are *perpendicular* letters. If it was necessary then to substitute perpendicular letters at all for oblique ones, we cannot see any valid reason whatever for preferring script to block letters. For ease in reading and in writing, the latter are very much to be preferred, though, strange to say, M. Hospitalier seems to think otherwise. The greatest practical use which will be made of any system, apart from books, will be by the large army of professors and lecturers, and the time which would be saved to them and their students by the adoption of the easy M and H instead of the troublesome French script is a matter for consideration. One thing is certain, that they would have to learn how to write a new alphabet. Apart from this, the block letters have been and are being used by nearly all the leading writers on magnetism of the present day. Ewing, Fleming and S P. Thompson all use them in their well-known work; and, *mirabile dictu*, the secretary of the committee which recommended the use of *script* letters, Prof. Nichols, of Cornell University, in his newly published *Laboratory Manual of Physics and Applied Electricity*, himself uses repeatedly, between pp. 201 and 205, *block* letters to represent magnetic quantities. Regarding the vexed question of *C* or *I* for current strength, we are decidedly of opinion that to use *I* would oblige teachers to explain the French use of the word "intensity," and that this would lead students to form a totally wrong idea of what strength of current actually means. In short, as Prof. Jamieson has tersely put it in his strictures on the Committee's recommendations, this word "intensity" has *no meaning* to English speaking people when used in this sense, and would very likely never be used. Why then prefer the initial letter of "intensity," a word which will never be heard, before that of the word "current," which is in constant use by British, Americans, and foreigners alike? If the American Institute of Electrical Engineers adopt the symbol *I* to represent current, they will prove false to the recommendations of their own Badge Committee, which, in the face of the recommendations of the Congress Committee, adopted as *their* mystic symbol the well-known formula $C = \frac{E}{R}$. (For illustrations, see the *Electrical World*, December 2, 1893, p. 424.) Does not this look somewhat like a tacit vote of censure? It is evident that Prof. Macfarlane agrees with Prof. Jamieson's suggestion about the use of the solidus (/) instead of the colon (:) for *per*. In regard to his other objections, we may take another opportunity of discussing them more in detail.

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* From *The Electrical Review* (London.)

[Why will our esteemed contemporary, the *Electrical World*, persist in making itself ridiculous on the unit question? If it only could see itself as others see it, it would find some way to stop the silly vaporings on units and nomenclature that are constantly making it the laughing-stock of the electrical community. If now our system of linear units were based on π then—oh! no, we have gotten off on the wrong tack now;—but the point is that the *Electrical World* editorially indorses the use of script or *oblique letters* as symbols for quantities, and *perpendicular* letters for the names of units or their abbreviations, and then, as if in sarcasm, *uses perpendicular letters* as symbols for quantities. But this was probably only another slip of the pen such as that which caused the same journal (heaven save the mark!) to say—"the ratio of the circumference to the diameter would be unity."—Ed.]

An Incandescent Lamp Antedating Farmer or Goebel.

The Dundee (Scotland) *Advertiser* contained the following announcement in its issue of July 31, 1835:

> Mr. Lindsay, a teacher in town, formerly lecturer to the Watt Institute, succeeded, on the evening of Saturday, 25th July, in obtaining a constant electric light. It is upwards of two years since he turned his attention to this subject, but much of that time has been devoted to other avocations. The light in beauty surpasses all others, has no smell, emits no smoke, is incapable of explosion, and not requiring air for combustion can be kept in sealed glass jars. It ignites without the aid of a taper, and seems peculiarly calculated for flax-houses, spinning-mills and other places containing combustible materials. It can be sent to any convenient distance and the apparatus for producing it can be contained in a common chest.

A few weeks later the inventor made the following statement:

> Brilliant illumination will be obtained by a light incapable of combustion, and on its introduction to spinning-mills conflagrations there will be unheard of. Its beauty will recommend it to the fashionable, and the producing apparatus framed may stand side by side with the piano in the drawing-room. Requiring no air for combustion and emitting no offensive smell it will not deteriorate the atmosphere in the thronged hall. Exposed to the open air it will blaze with undiminished luster amidst tempests of wind and rain, and being capable of surpassing all lights in splendor it will be used in lighthouses and for telegraphs. The present generation may yet have it burning in their houses and lighting their streets. Nor are these predictions the offshoot of an exuberant fancy or disordered imagination. They are the anticipated results of laborious research and of countless experiments. Electricity, moreover, is destined for mightier feats than even universal illumination.

It is evident that Mr. Lindsay was an early worker in the incandescent lamp field, and more than evident that he was a good prophet.

Telegraphic portraiture, or the telegraphic transmission of portraits, which has been accomplished with more or less success both here and abroad, is strongly advocated by M. Bertillon, the inventor of the system of identification now practised by the Paris police. He believes that it can be used with great effect in rapidly sending from place to place the pictures of criminals as an aid to the police of other cities.

To Reduce Flesh.

Prof. F. B. Badt's Advice to His Fat Friends.

Prof. F. B. Badt, of Chicago, has had printed for the benefit of his many friends who are troubled by too rapid growth in waist measurement a little folder showing what a man may eat and what he should avoid if he wants to preserve a normal weight. As a testimonial for the suggested treatment the Professor states that his own weight was reduced about fifty pounds two years ago and that he now has no trouble in keeping it down. He says:

> Obesity is an over accumulation of fat under the skin and around certain internal organs. Health cannot be long maintained under excessive obesity, as the accumulations of fat in the chest and abdomen occasion serious embarrassment to the functions of the various organs in those cavities.
>
> A luxurious, inactive or sedentary life, with over-indulgence in sleep, over-feeding and the excessive use of alcoholic liquors are the causes. Fatty, starchy and saccharine food of any kind is especially hurtful.
>
> Indigestion, sleeplessness, nervous indecision, palpitation of the heart, irregularity of the bowels, rheumatism, gout, neuralgia, diabetes decipiens, and many other complaints are usually directly traceable to the same causes, even if not accompanied by obesity.
>
> Proper care of the skin, cold baths in the morning, massage, plenty of exercise and proper diet will cure these complaints.
>
> The less exercise the stricter should be the diet.

SUGGESTED BILL OF FARE.

MAY TAKE

Soups, etc.
Beef, Mutton and Chicken Broth.
Fish, all kinds.
Meat.
Lean Beef. Lean Mutton. Chicken. Game.
Eggs.
Vegetables.
Asparagus. Cauliflower. Onions. Celery. Cresses.
Spinach. White Cabbage. Tomatoes.
Radishes. Lettuce. Greens. Squash. Turnips.
Bread and Farinaceous Articles.
Stale Bread and Toast, sparingly. [1]Gluten Bread.
Gluten Biscuits.
Desserts, Fruits, etc.
Grapes. Oranges. Cherries. Berries. Acid Fruits.
Drinks.
Water, plentifully, if excretion of urea is deficient. Pure
(preferably distilled) [2]Water, especially before
breakfast.
Tea or Coffee without sugar or milk. Wine occasionally.
Exercise plentifully.

AVOID

Fat, thick soups, sauces and spices, hominy, oat meal, maccaroni, white and sweet potatoes, rice, beets, carrots, starches, parsnips, puddings, pies, cakes, all sweets, milk, water (if urea is in excess), alcoholic drinks, malt liquors. Avoid water in excess with meals.

Note 1—Gluten flour is excellent food for general family use. It is not medicine.

Note 2—Pure distilled water, of ordinary temperature, say about 70° F., is to be preferred to any mineral water, as its dissolving power is greatest.

Do not drink water immediately before or after your meals. The rule of Bismarck's physician is as follows:

1 tumbler of water one hour before breakfast.
1 " " 50 minutes " "
1 " " 40 " " "

Do not take medicines of any kind!

If Prof. Badt's advice to fat men is as well received as his practical electrical handbooks have been, he will be doubly honored.

Recent letters from India inform us that the electric light is displacing gas light wherever ample water power for running dynamos is available. In Jeypore a gas generating plant which for many years had been engaged in making gas from castor oil has closed its works, and the electric light company has installed an efficient plant fitted with several United States patented appliances. The cost of making gas at Jeypore was 4.56 a thousand cubic feet, and owing to the engineering difficulties in the way of mains, much of the output was delivered to customers in tanks holding 50,000 cubic feet. We are pleased to learn that the proprietors of the gas works have built the electric lighting plant, and turned their gas generating plant into a manufactory of lampblack. We advise other owners of gas works to go and do likewise.

Mr. Allen, of Melbourne, Australia, has invented an electric submarine torpedo boat which, he maintains, can be sunk to any depth, and can be run as fast as a surface boat. It can be kept submerged for fifty or sixty hours.

ELECTRIC LIGHT ACCIDENTS.

(From our London Correspondent.)

On Saturday, November 10, in the afternoon, an accident occurred in one of the streets of the city of London which is to receive the attention of the Board of Trade. While a man was driving a one horse brougham along Cannon street his horse suddenly fell, shaking violently. The driver and his companion both jumped down to the assistance of the animal, but were unable to do any good as they received severe electric shocks. Meanwhile the horse's body was being shaken to and fro on the roadway; it was foaming at the mouth and blood was issuing from its nostrils. About three minutes after it was dead. Simultaneously two of the main boxes of the City of London Electric Lighting Company exploded, the covers being forced off. Three men who were injured had to be taken to St. Bartholomew's Hospital. The company give the cause of the explosion as the ignition by the electric current of an accumulation of gas. The whole of the circumstances are to be reported to the Board of Trade. Similar accidents have occurred in a number of provincial towns within the past year or so, but none with such serious results. At Bournemouth recently a horse was killed, some dogs upset and considerable damage done by a very similar affair, and the Board of Trade held an inquiry into the matter. At Glasgow, also, early in November, several main box covers were blown off and several people injured, though not very seriously. Electrical engineers in London are giving a good deal of attention to this matter, endeavoring to find some means for preventing these accidents. The gas companies seem to be the most to blame in the matter.

LEGAL NOTES.

The Weston Electrical Instrument Company has filed bills of complaint in the United States Circuit Court at Philadelphia against Queen & Co., alleging infringement on plaintiff's patents on measuring instruments and on galvanic batteries.

The real estate, machinery, rights, patents, privileges and appurtenances of the Thomson-Houston Electric Company of New York have been sold under foreclosure. This company was originally the East River Electric Light Company, but getting into difficulties changed its name to the Thomson-Houston Company of New York. Last January it went into the hands of a receiver. The Holland Trust Company, as trustee for the bondholders, foreclosed on the property of the concern in default of the interest on $600,000 of mortgage bonds.

The sheriff has received three executions against Bloomer Brothers & Co., electrical contractors at No. 26 Cortlandt street, New York, aggregating $2,289, in favor of the following creditors: Davidson Ventilating Fan Company, $905; Bryant Marsh Company, $701; Stanley & Patterson, $683.

The suit of the Mather Electric Company of Manchester, Conn., against the Waring Electric Company has been settled, the defendants having agreed to pay the plaintiffs $913.71, and $45.64 costs.

A judgment for $31.955 on notes has been entered against the Eastern Electric Company of New Brunswick and J. F. Zebley, a New York broker, in favor of the Edison General Electric Company. Zebley is the indorser of the notes.

A trolley car on a Philadelphia line a few days ago caught fire, and the frightened passengers were frantic in their efforts to get out. Two fat men endeavored to squeeze through the doorway at the same time and got wedged in so that they could not budge either way, and the air was rent with groans. With some assistance from the pressure of the crowd within, they finally succeeded in getting through the door and off the car. It was a narrow escape—for them. The other passengers got out without injury.

The Great Western Mfg. Company Confesses Judgment.

The Great Western Manufacturing Company confessed judgment in the U S. Circuit Court at Chicago, Dec. 1, on a note for $15,000 payable to Mary J. Lamb, who has loaned the corporation large sums at various times. The company has a capital stock of $1,500,000, represented for the most part by patents and franchises. Its liabilities are $300,000 and its assets are said to amount to $700,000.

Lectures at Union College.

Prof. Landreth of Union College is arranging for a series of lectures on the various practical applications of the electric current, to be delivered before the students of that institution this winter.

General News.

What is Going on in the Electrical World.

Jersey City, N. J.—An electric light plant is to be put in at the High Service pumping station.

Columbiana, Ohio.—This village is preparing to put in a complete electric light system and waterworks plant.

Georgetown, S. C.—Marks Moses has taken the initiatory steps towards establishing an electric light plant here.

Chattanooga, Tenn.—The sale of the Chattanooga Electric Light Company's plant has been postponed until December 20.

Galesville, Wis.—The village board has passed a resolution granting a fifteen-year franchise to D. M. Benton & Co for electric lighting.

Peekskill, N. Y.—The board of trustees has given a franchise to the Peekskill, State Camp and Mohegan Railroad Company for its proposed trolley road.

Elwood, Ind.—The Elwood Electric Light and Street Railway Company have received the insurance on their plant, recently wrecked, and will rebuild at once.

Appleton, Wis.—The Appleton Edison Electric Light Company is said to have decided to build and operate an interurban railroad from Appleton to Kaukauna.

Macon, Ga.—This city and Atlanta are now within speaking distance of each other by means of the long distance telephone line which was formally opened last week.

Green Bay, Wis.—The Wisconsin Telephone Company has completed its long distance metallic circuit between Milwaukee and this city and the line is now in operation.

Egg Harbor, N. J.—The question of building an electric light plant and waterworks is agitating the people of this place, with good prospects that the improvements will be made.

Brockport, N. Y.—The application of the Brockport Electric Company for an order of voluntary dissolution has been granted. The company was capitalized at $15,000.

Omaha, Neb.—The Citizens' Electric Light and Power Company has been awarded the contract for street lighting for one year at $109.50 per lamp for 200 or more arc lights.

Pierce City, Mo.—Preliminary arrangements have been made for the organization of the Pierce City Telephone and Messenger Company, which will start with a capital of $20,000.

Albany, N. Y.—The annual report of State Engineer Adams will contain a recommendation that electric power be used as a method of propulsion for canal boats on the State canals.

Youngstown, O.—The Orient Electric Works has resumed operations and will likely continue. The company does not anticipate any more trouble from the Edison company on account of patents.

Elizabethport, N. J.—The Singer Machine Works here will henceforth be lighted by electricity instead of gas. The company will generate its electricity the same as for many years it has made its gas.

Binghamton, N. Y.—Capitalists here are considering the building of an electric road from Binghamton east to tap the following towns: Conklin, Kirkwood, Corbettsville, Great Bend, Hallstead and New Milford.

Rochester, N. Y.—Geneva Valley Park is to be made an attractive resort, and a fleet of electric launches will be put on the river to add to the pleasure of visitors. A Philadelphia company has the scheme in hand.

Mt. Holly, N. J.—The Mt. Holly, Lumberton and Medford Railroad and the Vincentown Branch Railroad have been leased by the Pennsylvania Railroad to a company who will operate them under the trolley system.

Greenfield, Ind.—O. C. Irwin has asked the court to appoint a receiver for the Greenfield Electric Light and Power Company. The company has been in existence two years. The liabilities and assets are unknown.

Springfield, Ill.—A project is now on foot to put in a new system of electric lights at the University of Illinois and telephonic connections between all buildings. The plan is to run the wires underground through pipes.

Oskaloosa, Ia.—The Edison Light Company of this city has lately purchased of the Siemens & Halske Company of Chicago two 125 K. W. direct current machines, giving them the preference over the machines of the parent company.

Reading, Pa.—The firm of Matthews & Hartman who received a patent on an automatic electric lighter on October 2, have already fitted up a number of engine houses with it. The appliance starts the fire instantaneously with the movement of the engine.

Toronto, Can.—Sir Adolphe Caron, Postmaster-General, who lately visited New York to examine the postal electric service there, was favorably impressed with the utility of the system, and it is probable that steps will be taken at once to introduce the system in Canada.

Wheeling, W. Va.—The *Intelligencer* states that the project of erecting a waterworks and electric light plant combined at Elm Grove for the benefit of the residents of that village and those living between that point and this city is rapidly assuming a definiteness which assures its consummation.

Flushing, N. Y.—The Newtown Railway Company has obtained a franchise to operate an electric system in the town of Newtown from the point bordering on Long Island City to the Flushing line. The company already has a franchise to operate in Long Island City and also in Flushing.

Kalamazoo, Mich.—The city council has ended the lighting controversy by voting to buy the Kalamazoo Electric Company's electric apparatus and a site for $12,600, and contracting with that company to run lights until the plant is installed at 25 and 50 cents per light for midnight and all night lamps.

Islip, N. Y.—Application has been made to the Islip town board by a syndicate composed of the Austral Hotel Company and the Electrical Construction Company of New York for a franchise to run a trolley line from Brentwood, L. I., southward to Bay Shore, and thence to the westerly boundary line of the town.

Detroit, Mich.—Greene Pack, Albert Pack and H. A. Everett have petitioned the city council for a railway franchise on about thirty miles of our streets. The petition sets forth that the company expects to build a rapid transit railway upon the most approved plan and with the best of modern machinery and appliances.

Kansas City, Kan.—It is stated that Robert Fleming, the English capitalist, who is the chief financial backer of the Kansas City Cable Railway, has recently purchased a large interest in the West Side Electric road, and the inference drawn from this is that the roads will be consolidated and placed under one control.

Batavia, N. Y.—The New York Construction Company have asked for a franchise to construct an electrical street railway in this village. The proposed route of the road is through the principal streets of the village and to Horseshoe Lake. It is proposed to use either the trolley system or carbon motors as a motive power.

Cape Girardeau, Mo.—Gannon Bros. have purchased the Home Electric Light plant of Hartsell & Son here and will put in new machinery, consisting of a 1,000-light incandescent and a 50-light arc machine. They have a contract for lighting the city for ten years with twenty-two arc lights, to be run by them in connection with the waterworks plant, which will be in operation on or before the 1st of January.

Akron, O.—The local street railway system is to be greatly improved. The Sprague motor, hitherto used, is to give place to a new machine supplied by the Walker Manufacturing Company of Cleveland. It is of the single reduction type, having but one-half of the present gearings. It will be of twice the horse power of the present Sprague motor.

Clarksburg, W. Va.—The Clarksburg and Suburban Street Railway Company, whose incorporators are R. S. Gardner, Lee H. Vance, Marcy McD. Price, C. M. Hart, J. H. Horner and Frank Mattox, has been granted a franchise for twenty-five years by the town council of Clarksburg to use and occupy certain streets of the city for the construction and operation of a street railway to be run by electricity.

Salt Lake City, Utah.—The waters of the Provo cañon are to be utilized in generating electricity for the operation of machinery of any magnitude and at distances embracing all the towns of Utah County, Eureka and Salt Lake City. In carrying out the project surveyors are now upon the ground at which it is proposed to construct the dam and it is said that behind it is capital abundantly capable of carrying out the project.

Newark, N. J.—The New Jersey Street Railway Company have asked the Board of Freeholders for permission to run a double track trolley line from the end of the Consolidated Traction Company's line through Clinton Township, South Orange and Milburn. The same company also petitioned for a franchise for an electric road through the township of Bloomfield, the town of Montclair, and through the townships of Verona and Caldwell.

Westport, Conn.—Francis W. Marsh, of Bridgeport, Charles Fable, F. D. Ruland, M. D., W. E. Osborne and Charles Harris, of Westport, have given notice that they will petition the coming Legislature to incorporate them as the Westport and Southport Tramway Company to build a trolley line from Lyons Plains in Weston to Westport, through Westport to Saugatuck, thence to Green Farms and Southport, there to connect with the system of the Bridgeport Traction Company.

Syracuse, N. Y.—The Electric Engineering and Supply Company has just completed what is thought to be the largest and finest switchboard ever constructed for the electric lighting equipment of a hotel. It was designed by L. W. Emerick for the new Hotel Raleigh in Washington. The switchboard is composed of Italian marble, brass and birdseye maple. Its dimensions are 7 x 10 feet, and through its aid complete control of over 4,500 lights can be exercised by one man·

Winchester, Ohio.—The construction of the Manchester and Northern Railroad, an electric line between Manchester and this city, via West Union, a distance of 24 miles, has been revived and indications are that it will be built. Frank E. Holliday, the projector of the scheme, who recently secured the franchise, has, it is said, sold his interest in the road to the Highland Construction Company of Chicago, who were some time ago awarded the contract for building the line.

Milwaukee, Wis.—The plant of the Milwaukee Arc Light Company has been sold to four of the directors who were incorporators of the company. The directors who have assumed control of the business and of the liabilities are F. C. Ehlers, Charles Kirchhoff, Jr., J. J. Kempf and Dr. W. H. Earles, the latter being president of the old company.—A bill authorizing this city to establish and maintain an electric lighting plant is to be presented at the next session of the Legislature for its action.

Harrisburg, Pa.—The Conewago Water and Water Power Company has been granted a charter at the State Department. The company proposes to operate the water power of the Susquehanna River at or near Falmouth and at such other points as may be found available by the company. The aggregate water power to be controlled is about 10,000 H. P., which will be utilized for the purpose of generating electricity and transmitting it over the wires of the company to any given distance within a radius of 35 miles.

Traverse City, Mich.—The Boardman River Electric Light and Power Company gave a grand banquet on the 27th ult. in celebration of the formal opening of their electric plant. Guests were present from all over the State, many of them prominent people. The plant is located on the Boardman River. The dam is 700 feet long and the works the most extensive in Michigan, operated on the tri-phase system. It is one of Traverse City's most extensive enterprises, requiring a large investment. Frank Friederich is president of the company.

Hamilton, O.—The Hamilton Canal Boat Company has purchased a warehouse in Dayton and the line may possibly be extended to Toledo. The new company has bought from the Miami Transportation Company the franchise for the use of the berme bank for the erection of poles, wires, etc., for electric power. Of this company, ex-Senator J. C. Richardson, of Lockland, is president, John W. Clements, of Hamilton, secretary and treasurer, Chas. T. Hayman, of Cincinnati, vice-president, and J. C. Richardson general manager.

Fillmore, N. Y.—The Northern Allegany Telephone and Electric Light Company, organized a few months ago, has opened a line from Fillmore to Wellsville with an extension to the village of Hume. The line is equipped with copper wire and was built for less than $100 a mile. The officers of the company are: President, Charles Ricker; vice president, Judge S. M. Norton, Friendship; secretary and treasurer, I. S. Hunt, Belfast; executive committee, Frank S. Smith, Angelica; S. M. Bartlett, Cuba, and J. R. Hodnet.

St. Louis, Mo.—A bill introduced in the city council and passed the first reading provides for the formation of a new telephone company and for the erection of its wires, poles, construction of conduits and other apparatus. The promoters are J. A. J. Schultz, William J. Kurtz, Thomas J. Ward, I. Ricord Gradwell, Joseph M. O'Shea, Andrew J. Haley, Louis J. Oswald and T. J. Hennessey. The annual rates for the use of telephones is $60 for business houses and $48 for residences. The compensation offered to the city is the use of a number of telephones, not to exceed forty, free.

Schenectady, N. Y.—P. C. J. De Angelis, the special master appointed by the court, will, on the 3d of January next, sell all the property of the Schenectady Street Railway Company. The property includes the lamps, buildings, franchises, charters, patents, contracts and leases, also the machinery and electrical appliances and apparatus belonging to the equipment of the street railway. An important item in the property to be sold is 797 shares of the capital stock of the Schenectady Illuminating Company and 658 shares of the capital stock of the Schenectady Gas Light Company.

Bangor, Me.—An electric street railroad is to be built from Norway to Paris. A company has been organized and directors elected. J. Manchester Haynes and Orville Baker are large holders of the $25,000 worth of stock issued. Another electric railroad is projected from Bryant's Pond to Andover, connecting the Grand Trunk Railroad with the lake region and fine fishing and hunting grounds. This route will wind along the fertile valley of the Androscoggin about twenty-three miles, and connect the villages of Bryant's Pond, North Woodstock, Rumford Point, Rumford Center, Milton, North Rumford, South Andover and Andover.

Savannah, Ga.—A petition for the incorporation of the Chatham Electric Light and Power Company has been filed in the Superior Court. The petition sets forth that the incorporators are Messrs. George Parsons, Henry Parsons, J. H. Johnston, J. N. Harriman, Edward J. Thomas, C. S. Hardee and Pope Barrow. The purpose of the company is to furnish lights by electricity in the city of Savannah and immediate neighborhood for streets, lanes, squares, roads, buildings, rooms, wharves and all other places where lights are desired. The capital stock is $25,000. There seems to be no doubt that this is another move on the part of the City and Suburban and Coast line people against their competitors, the Electric Railway Company. It is well known that the latter company owns $125,000 of the $375,000 stock of the Brush company, which at present furnishes light for the city.

Pittsburg, Pa.—A coal operator here who is a strong advocate of machine mining, and who recognizes the disadvantages this district labors under in competing markets owing to heavy freight rates and the cheaper production of machine mined coal in Ohio and other Western States, says: "Pittsburg thin vein operators with their superior quality of coal have it in their power to force the equalization and in doing it will add double value to their properties. When this is fully realized there will be a harvest for electric and mining machine builders. In this district alone there is in sight now over $1,000,000 worth of work for them: That company which will enter this field and prove to the operators the value to them of their machinery will be liberally rewarded in getting all the work it can do for years to come."—Three Pittsburg street railway companies were chartered at Harrisburg last week, to wit: The Baum Street Railway Company, capital, $10,000; the Highland Park Street Railway Company, capital, $25,000, and the Liberty Traction Company, capital, $70,000.

INCORPORATIONS.

The Connersville Gas and Electric Company, Connersville, Ind.—to manufacture and supply electric light and gas. Capital stock, $150,000. Promoters: H. W. Miller, C.F. Mosier, Geo. W. Combs.

The Nokomis Electric Light and Power Company, Nokomis, Ill.—to furnish electric light, etc. Capital stock, $10,000. Promoters: R. E. Cornelius, Geo. Bliss, Garret Carstens.

The Merced River Power and Water Company, San Francisco, Cal.—to build, own and operate railways, bridges, telegraph and telephone lines, water works, flumes, dams, and distribute water, electric and other power for all purposes. Capital stock, $1,000,000. Promoters: G. A. Wulkop, Merced, Cal.; Summer W. Bugbee, Oakland; H. L. Norton, F. C. Roberts, W. S. Morgan, San Francisco.

The Stockton Gas and Electric Company, San Francisco, Cal.—to manufacture, use and transmit gas and electricity for light, heat and power, etc. Capital stock, $1,000,000. Promoters: August Muenter, Stockton, Cal.; W. B. Kollmyer, Chas. C. Green, F. W. Longee, Rob't M. Welch, Edw. R. Taylor, San Francisco; Edw. Barry, Oakland.

The Dynamo-Electric Maintenance Company, Hoboken, N. J.—to make contracts; maintain electric dynamos, motors, wires, fittings and appliances. Capital stock, $500,000. Promoters: Geo. F. Dinsmore, Rob't S. Ashe, Boston, Mass.; Leon Abbett, Jr., Hoboken.

The Dearborn Electric Company, Chicago, Ill.—to manufacture and sell electrical apparatus and electrical supplies. Capital stock, $25,000. Promoters: T. C. Rafferty, Chas. Messer, J P. Rafferty.

The J. J. Norman Company, Chicago, Ill.—to manufacture and deal in electric appliances, hardware, etc. Capital stock, $100,000. Promoters: J. J. Norman, E. A. Lauson, A. Nott.

The Luling Electric Light and Power Company, Luling, Tex.—to furnish the city of Luling with electric light and power, and buy and sell electrical supplies. Capital stock, $20,000. Promoters: W. R. Johnson, David Gregg, F. B. Starr, Jr., H. Kleinsmith, all of Luling.

The Citizens' Light and Power Company, Sullivan, Ind.—to supply light, heat and power. Capital stock, $15,000. Promoters: Noah Crawford, Silver Cheney, Mary A. Crawford, Sullivan.

The Tacoma Traction Company, Tacoma, Wash.—to construct and operate street and other railways, build sidewalks, streets, etc. Capital stock, $500,000. Promoters: Stuart Rice, Geo. B. Blanchard, Chas. S. Fogg.

The Merchants' Electric Company, Marceline, Mo.—to do electric lighting. Capital stock, $6,000. Promoters: Geo. W. Early, W. A. Cates, W. A. Cannon, of Marceline.

The Jamaica Construction Company, Haddonfield, N. J.—to build, construct and equip electric street railways. Capital stock, $100,000. Promoters: Edw. Ilsley, Walter C. Smith, Philadelphia, Pa.; Jno. McNeill, Haddonfield, N. J.

The Toltec Coal Company, Denver, Col.—to buy, sell and work coal lands, construct and operate electric railway in connection with same, etc. Capital stock, $50,000. Promoters: Pliny F. Sharp, John McNeil, Paul Lantus, of Denver.

The Shore Electric Company, Red Bank N. J.—to manufacture and generate electricity, light, heat and power, etc. Capital stock, $100,000. Promoters: Frederic W. Ward, East Orange, N. J.; Harry P. Chandler, Newark, N. J.; Percy Ingalls, Verona, N. J.

The Standard Electric Company, Philadelphia—to supply electric light, heat and power. Capital, $1,000. Incorporators: Joseph A. Goodfellow, Thomas M. Carlin, Irvin S. Deakin, James Nolan and Otis Egan.

The Magnetawan Tanning and Electric Company, Toronto. Capital stock, $50,000. Incorporators: Cecil G. Marlatt and Wilbur T. Marlatt, of Oakville, tanners; John Waldie, lumber merchant, and William Cameron, salesman, of Toronto, and Robert J. Watson, tanner, of Burk's Falls, Can.

The Portland and Yarmouth Electric Railway Company, Portland, Me.—to establish and operate an electric railway line. Capital stock, $200,000. Edward S. Perry, of New Haven, Conn., is president of the company; James O. Mayo, of Naugatuck, Conn., vice-president, and John S. Bradley, of New Haven, Conn., treasurer.

The Mount Washington Electric Railroad Company, Baltimore—to build and operate an electric railway line. Capital stock, $150,000. Incorporators: George R. Webb William G. Webb, Charles W. Hatter, Oscar C. Martinet and John W. Middendorf.

The Union Electric Company, Hallstead, Pa. Capital stock, $10,000. Directors: B. Franklin Bernstein, James T. Du Bois, Theodore H. Hays, Hallstead; John A. Moore, Garrett Bogart, George M. Hallstead, Scranton; Alfred A. M. Creary, New York.

The American Gas Engine Electric Company, Chicago. Capital stock, $250,000. Incorporators: F. M. Charlton, John D. W. Rowe and Erik Akerberg.

The Chicago Electric Protective Company, Chicago, has certified to an increase of capital stock to $150,000.

The Goldfield Water, Gas, Electric Light and Power Company, Goldfield, El Paso County, Col.—to supply the town of Goldfield with light, etc. Capital stock, $100,000. Incorporators: Peter J. Frederick, Alois Koch and John L. Fragu.

Woven Wire Brushes.

The Belknap Motor Company of Portland, Me., are the patentees and manufacturers of the best Woven Wire Brush on the market.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED NOVEMBER 27, 1894.

ELECTRIC RAILROADS AND APPLIANCES.

529,701. Closed-Conduit Electric Railway. Charles G. Burke, Brooklyn, N. Y. Filed Feb. 10, 1894.

529,797. Closed Conduit for Electric Railways. Frederick L. King, Chicago, Ill. Filed Jan. 15, 1894.

529,829. Trolley-Wheel. Frederick Lepper and William Wighton, Toronto, Canada. Filed Sept. 22, 1893.

529,836. Conduit Electric Railway. Leonidas C. Pressley, San Francisco, Cal. Filed Feb. 6, 1894.

529,903. Trolley-Wire Support and Coupling. Aaron P. Gould, Canton, Ohio. Filed March 7, 1894.

530,033. Supply System for Electric Railways. Zebulon Foster, Chicago, Ill. Filed March 7, 1894.

DYNAMOS, MOTORS, ETC.

529,688. Means for Supporting Motors in Electric Locomotives. Walter S. Adams, Philadelphia, Pa., assignor to John A. Brill, same place. Filed Nov. 9, 1893.

529,710. Sectional Thermo-Electric Generator. Harry B. Cox, Hartford, Conn. Filed Jan. 31, 1894.

529,711. Thermo-Electric Generator. Harry B. Cox, Hartford, Conn. Filed Jan. 31, 1894.

529,784. Commutator-Brush for Dynamos. George Forbes, London, England. Filed Aug. 8, 1892. Renewed April 14, 1894.

529,918. Alternating-Current Generator. John F. Kelly, Pittsfield, Mass., assignor to the Stanley Laboratory Company, same place. Filed Aug. 18, 1894.

529,992. Conductor-Coil for Armatures and Field Magnets, and Method of Making Same. Emra W. Alexander and Henry Groswith, Philadelphia, Pa. Filed Sept. 22, 1893.

530,032. Electric Elevator-Motor. Wendell C. Fletcher, St. Louis, Mo., assignor of one-half to Edward W. Moon, same place. Filed June 14, 1894.

TELEPHONE AND TELEGRAPH APPARATUS.

529,818. Telephone. Alfred Stromberg and Androv Carlson, Chicago, Ill. Filed Oct. 9, 1894.

529,826. Telephone-Switch. Edgar S. Combs, Rochester, N. Y., assignor of one-half to Irving Paine, same place. Filed Oct. 9, 1894.

SIGNALS AND SIGNALING APPARATUS.

529,759. Electric Signal for Railway Crossings. Daniel W. Smith, St. Louis, Mo., assignor, by direct and mesne assignments, of two-thirds to Alfred Bevis and Chas. H. Longstreth, same place. Filed Sept. 10, 1894.

529,812. Railroad-Signal. Charles Selden, Baltimore, Md. Filed Jan. 4, 1894

529,894. Signaling Apparatus for Telephone-Exchange Systems. James H. Cary, Malden, assignor of one-half to Luther P. Bryant, Northampton, Mass. Filed March 17, 1894.

529,920. Signal for Cable Railways. Gottfried F. Klaffky and Frank Faltinowsky, New York. Filed May 8, 1894.

529,949. Electrical Danger-Signaling System. William A. Phillips, U. S. Army. Filed May 29, 1893.

529,984. Electric Signal Apparatus. Horace E. Walter, Richfield Springs, N. Y. Filed Jan. 9, 1893.

529,985. Electric Signaling Apparatus. Horace E. Walter, Richfield Springs, N. Y. Filed March 26, 1894.

529,986. Electric Signaling Apparatus. Horace E. Walter, Richfield Springs, N. Y. Filed April 26, 1894.

MISCELLANEOUS.

529,898. Rotatable Electric Contractor. John W. Curry, Cairo, Ill. Filed July 9, 1894.

529,975. Speed Indicator and Alarm. George A. Thompson and John F. Schmadeke, Brooklyn, N. Y. Filed April 27, 1894.

529,999. Switchboard. Louis A. Berthon, Paris, France, assignor to the Societe Generale des Telephones (Reseaux Telephoniques et Constructions Electriques) same place. Filed Oct. 17, 1893.

530,004. Electrical-Contact Mechanism. John F. Blake, New Haven, Conn. Filed June 21, 1894.

530,019. Box or Furnace for Electric Heating Apparatus. Charles L. Coffin, Detroit, Mich. Filed March 9, 1893.

530,020. Apparatus for Welding Rings. Charles L. Coffin, Detroit, Mich. Filed March 13, 1894.

530,021. Method of Electrically Heating Metal. Charles L. Coffin, Detroit, Mich. Filed July 10, 1894.

530,022. Combined Railway-Switch and Car-Replacing Mechanism. Albert S. Debose, Cuero, Tex. Filed July 14, 1894.

530,053. Electric Robe, Towel, etc., for Heating. Henry G. O'Neill, Boston, Mass., assignor of one-half to Edward Jewell, same place. Filed April 9, 1894.

530,066. Plug and Receptacle for Electrical Purposes. David J. Cartwright, Boston, Mass. Filed Jan. 24, 1894.

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The Welsbach Light.—Our article on this subject in the issue of November 28, along with the similar matter in this issue, have been reprinted in pamphlet form. The pamphlet is now ready for delivery and will be sold to Central Station men and others at the rate of $15 per 1,000. It has been universally pronounced the most comprehensive treatise on the subject yet printed.

EDITORIAL NOTES.

The Welsbach Gas Burner. The *Progressive Age*, one of the staunchest of our gas contemporaries, in its issue for December devotes over a page to an editorial on the subject of incandescent gas lighting, of which the following is worthy of repetition as representing the situation from the gas man's standpoint:

"Within the past six months the Welsbach has made gigantic strides in popular favor, nor is it to be wondered at half so much that such is the case as it is to understand why the light did not long ago achieve the distinction now so willingly accorded it on every hand. While it is true new features have of late been added that have contributed to the perfection of the light, such as increased duration of mantel, short chimney and possibly increased illuminating power, together with the overcoming of that ghastly glare justly objected to by observers of the earlier lights, we nevertheless maintain that the light of this type of five and six years ago was without equal; today it is the accepted standard of those seeking more light for less money.

"We have waited with some trepidation the coming of comments that we believed our electrical contemporaries could not much longer withhold, since the central station electric plants have been experiencing a marked decrease in business wherever the Welsbach has been placed in active competition, and naturally managers of electric light properties have awakened to the fact that gas as an illuminant is not such a back number as they would like to have it appear. On another page we publish a translation of the report of Prof. Renk, of the Hygienic Department of the Halle University, together with comments of Dr. Bunte thereon which appear in a late number of his paper, the *Journal fur Gasbeleuchtung*, and also the remarks on the burner of Dr. Kruger, of Berlin, made by him at the recent meeting of the German Gas Association. The eminent qualifications of either of these gentlemen justify great confidence in any statement that they may make respecting gas and its uses. Individually any one of them opposing M. Gréhant's argument would be entirely sufficient, but collectively they do not leave that reckless Frenchman a leg to stand on."

It will be remembered that M. Gréhant was the French chemist who has been widely quoted as having found the deadly carbon-monoxide gas among the products of combustion issuing from the chimney of the incandescent gas burner. To refute this, Prof. Renk is brought forward, who states that he did not find any in his tests, and we have one of those Franco-German personal-national rows which are pretty sure to arise whenever there is the least excuse for them, but which usually have no interest to others than the immediate disputants. Unfortunately for the *Progressive Age's* argument and for its authority, Prof. Renk says too much. He gives his methods of analysis, by which he states in one case he did not find carbonic oxide gas, by which in another he did find it, and by which in still another he found it where he admits it probably did not exist. Prof. Renk uses as his reagent for determining the presence of carbonic oxide the chloride of palladium. Now this only shows the presence of a reducing agent, which assists the palladium to occlude hydrogen by taking oxygen from the vapor of water which may be present. His method is therefore entirely unreliable, and his results would be equally worthless whether he found large quantities of the gas or none, for exactly similar results can be obtained where there is absolutely no carbonic oxide present. Much stress is also laid upon the blood test for this gas, which in Prof. Renk's hands produced negative results. Now the blood test, when made by competent investigators, is a splendid *corroborative* test, but is only valuable as such. We think no competent chemist would rely upon it for anything else than a corroboration of other results obtained in a reliable manner.

But even if Prof. Renk's tests were thoroughly reliable, which on the face of them they are proved not to be, we see nothing inconsistent in two tests made at different times under different conditions, one of which shows the presence of the deadly gas in small quantities and the other one does not.

We stated in a recent issue that the carbonic oxide was probably largely due to the reduction of carbonic acid by the soot deposited upon the upper portion of the hood or mantel. Under favorable conditions we should not expect to find this gas where there was no deposition of soot, whereas we would expect to find it where the soot was present.

In nearly all of the arguments that we have seen against the possibility of there being any of the carbonic oxide formed, stress has been particularly laid upon the supposed fact that *because* the gas is burned in a Bunsen burner the combustion *must* be complete, and that therefore there can be none of the poisonous gas produced. There was never a greater fallacy than these conclusions, for the simple reason, as every one knows who has used the Bunsen burner much, that it is exceedingly difficult to so regulate and *maintain* the correct relation between the gas and air as to produce a perfect combustion. Some burners will always smoke whether turned up or down, and will smoke more when turned low than when high. No method has yet been devised that will absolutely prevent this smoking, except by going to the opposite extreme, whereby the tendency to burn down at the base is incurred, which is far worse in its results than the smoke. The trouble is therefore inherent in the Bunsen burner, and a given number of the latter without the mantels, which are the distinguishing feature of the Auer-Welsbach light, will vitiate the atmosphere of a room even more quickly than the same number of bat-wing gas burners using the same quantity of gas. If, however, we furnish a surface upon which this soot can be deposited and then act as a reducing agent upon the carbonic acid that is produced, as is the case with the incandescent gas lamp, the bad results are, or may be, very greatly increased.

Many are lulled into security from the fact that they can perceive no odor, and assume that for that reason no carbonic oxide is produced. This argument is in fact often brought forward to prove that it is not produced. Carbonic oxide, however, when perfectly pure *has no odor* whatever, and therein consists its greatest danger, for its presence is not suspected.

In our previous editorial on this subject, we referred to the use of mica chimneys being rendered necessary by the large breakage of glass chimneys. We learn now that even these do not give satisfaction, for the reason that they are apt soon to become smoked, and mica when smoked cannot be successfully cleaned. The question, therefore, resolves itself into whether it is cheaper to pay 50 cents for a mica chimney which will not break but must be thrown away when it becomes smoked, or buy the cheaper glass chimneys which can be cleaned but which break?

This chimney question is admittedly one of the most important in the economy of the Welsbach light, and the *Progressive Age* in its attempts to meet it, indiscreetly we think, quotes the remarks of Dr. Kruger made before the German Gas Association at Berlin. In his endeavor to show how good a new kind of glass is for this special purpose, he shows how bad the usual ones are. He says: "In seven weeks with 280 flames, 110 of the old chimneys were broken; in an equal period, 17 of the new. Of course, there was accompanying economy in hoods. There are now a great many kinds of chimneys in use; mica chimneys, rod chimneys, chimneys built up of replaceable strips, chimneys of mica below and glass above. A clear glass chimney is best when it can stand the heat. *All the others develop unexpected faults in the course of time.*" When it is remembered that the breakage of a chimney usually means the breakage of a mantel also, unless some one is present to immediately attend to matters, it will be apparent how serious this breakage of chimneys becomes.

As to the average life of the mantels, this same Dr. Kruger is quoted as saying that hoods giving 57 candles at first, give 33.7 after 4,000 hours. The advertising circular of the American manufacturers which is before us only claims an average *total life* of 500 hours, which shows something of a discrepancy between the claims of the two advocates. But let us see what the facts are so far as we can get at them. In Vol. C. xvi, Trans. Inst. Civil Engineers of Great Britain we find the following: "The Munich Gas Light Company find that the cost of maintaining Welsbach lights in Sendlinger Strasse is excessive. In four months fourteen mantels and twenty-five cylinders were required for renewals, *with four lanterns*."

From France, on the authority of one of the most eminent gas engineers in the country, we get the statement that the life of 600 hours is "an ideal maximum." In practice the life is about 400 hours.

In this country we have had the following experience among others: Early in September, we are informed, the Welsbach Light Company placed a number of lights in the lamps of Rittenhouse Square, Philadelphia, Pa., for the purpose of attracting the attention of the upper classes residing and traveling in that neighborhood. An expert handler of the light, we are told, is on hand six hours every night to maintain the lights in good working order. Thus far the breakage of mantels has been 40 per cent. greater than the record made in Munich.

We have not space to go further into the argument of the *Progressive Age*, but feel warranted in expressing the opinion that our contemporary has displayed very poor judgment in selecting its witnesses. The choice of Dr. Renk seems peculiarly unfortunate, in that he has said too much and flatly contradicts himself. Dr. Bunte, who is cited to substantiate Dr. Renk, unfortunately for his own argument, tries to belittle the poisonousness of carbonic oxide gas. If there is none generated, why is it necessary to attempt to prove its innocuousness? He says: "Dr. Meidinger, Professor and Court Councillor, who has long been combating this absurd carbonic oxide scare, when writing the other day on this subject, after remarking how much carbonic oxide is developed in the smoke of a cigar, supplied a *reductio ad absurdum* in the following words: '*Let us then give up cigar smoking; let us give up visiting public houses or restaurants, where the poisonous carbonic acid is accumulated a hundredfold; let us renounce every kind of conviviality and all the little comforts of life.*'" Dr. Meidinger, Professor and Court Councillor, might as well have argued that because you and I may have so accustomed our systems to arsenic, alcohol and tobacco narcotic that we can take them in quantity with impunity our wives and babies should be compelled to take them in the same doses as "little comforts of life." Surely this is a *reductio ad absurdum* of the *Progressive Age's* whole argument.

We believe that with the statement of the case that we have made editorially and the testimony in regard to the matter which we give in another column we have presented enough evidence to show to the unprejudiced reader that the merits of the incandescent gas light are not sufficient to give warrant to the fear of any *lasting* competition with the electric light. The claims for it are so plausible, however, and to the casual observer so enticing, that an ephemeral popularity and competition is sure to result. Its introduction is bound to make inroads among present patrons of the central station, and once introduced, on account of its high cost of installation ($2.25 to $2.50 per burner), will not be cast aside until its weaknesses have developed to an unbearable extent. In the meantime the central station as well as the consumer will be the losers. A stitch in time saves nine. Let the central station manager forestall dissatisfaction, raise the pressure on his mains so that his customers will have a bright and cheerful light as well as a healthy one, and both he and his customers will be the gainers thereby.

* * *

Mr. Dunn's Lecture. In Mr. Dunn's lecture which was delivered before the New York Electrical Society at the last regular meeting, that organization added another leaf to its history of usefulness, of which it is justly proud. The paper itself was a remarkable one in the literature of the science, not for what it expounded that was new, but for the extreme clearness with which were enunciated things that were known to the esoteric few, but which had not before been enunciated in a sufficiently clear manner to appeal intelligently to the exoteric many.

The occasion was one of unusual interest, as evinced by the presence of many electricians of note, some of whom are seldom seen at these meetings and had come considerable distances, and others of whom had given up other engagements to be present. An insight into the special significance of the occasion was given by the opening remarks of the president, who stated that Mr. Dunn was one of the first fruits of the Electrical Engineering course at the School of Mines, and called upon Dr. Pupin, whom, as one of the organizers of that course and a former instructor of Mr. Dunn, he introduced as his foster father. Dr. Pupin, after a few appropriate remarks, in which he dwelt upon the pride with which he and his associates had followed Mr. Dunn's career, introduced the speaker of the evening.

Then followed what we believe to be the clearest exposition of the subject in hand that has ever been given in the language, which more than justified the high expectations that had been aroused by Dr. Pupin's remarks. In any other department of science than electricity such a spectacle as was there witnessed is probably unheard of—grayhaired veterans in the profession listening in rapt attention to, and learning from the lips of a young man—so young in fact as to appear in years at least a mere boy, but who in bearing, experience and insight into the mysteries of the theme showed himself a man among men. But in electricity none grow old. Those who are inoculated with it while young are endowed with perennial youth, and those who only catch it after their locks are tinged with gray become young again. The inventor of the telautograph, the telephone, etc., etc., etc., who is sometimes accused of being gray, denied before the electricians' banquet at the World's Fair that it was due to age, for, he asseverated, he was a little Gray when he was born. And so it goes. Not all of the noted electricians who have made their mark are gray; some who are old in years deny that they are. There are few even of these who have received such a recognition, or whose utterances have merited such an approval, as did Mr. Dunn. It was indeed an occasion of which both Mr. Dunn and his many friends may justly feel proud.

The importance of this Paper and the discussion which followed it, the publication of which we commence in this issue, is such as to warrant its preservation. For this reason ELECTRICITY proposes to publish it shortly in pamphlet form, which may be had of the publishers at 10 cents per copy, postage prepaid.

That Cat Again.

The impression is gaining ground among the laity that the cat is getting in more work nowadays in the offices of our esteemed contemporary, the *Electrical Engineer*, than are the editors themselves. Our attention is called to an article in its issue of November 14, culled from the *American Engineer and Railroad Journal*, in which these remarkable statements go unchallenged:

"The motor *fields* are of the ironclad type, having each separate windings imbedded in the mica-lined slot cut into the periphery of the laminated iron armature.

"The *overhead work* necessary to generate the electric current to (sic) the locomotives has been specially designed and will at once be erected."

But how should the cat know that the separate windings of the fields are not usually imbedded in mica-lined slots cut into the periphery of the armature, or that overhead work has never been erected before to generate current to locomotives? We insist that it should not be expected of *any* cat that it should know all these things. Spare the poor cat, Brother Wetzler, and remember how you would feel if you were in its position. Be merciful, prithee, be merciful.

* * *

Preparing for Large Business.

The General Electric Company recently purchased in the Boston market 2,000,000 pounds of Lake copper at 9.6 cents per pound for January and February delivery.

Under the Searchlight.

Views and Opinions on Timely Topics.

MR SIGMUND BERGMANN is importing 10,000 Allgemeine incandescent lamps from Germany. Inasmuch as no foreign-make of lamps is equal to those of American manufacture, it is difficult to see what Mr. Bergmann is going to do with these lamps when he gets them.

* * *

PROF. JOHN S. MCKAY will lecture before the Brooklyn Institute this week on "Optical Illusions." No doubt he will take for his text the storage battery plant mentioned by us last week, and Mr. Stockley's telegram in regard to it.

* * *

THE Toledo windbag was punctured before its inflation was completed, and the consolidation deal is off. Mr. Coffin will have to wait some time before he can make a trade that will render the $194,000 of bonds on his lighting plant there of any value.

* * *

To Advertise the Quacks.

(From the Portland Oregonian.)

Portland policeman will not suffer from cold this winter if any benefit can be derived from the wearing of electric insoles. Some dealer in this line of goods, acting on the strength of a benevolent impulse or endeavoring to get rid of a job lot of goods, has presented every policeman with a pair of patent insoles, studded over with copper buttons and guaranteed to protect the feet from any and all manner of ills.

The city fathers should now make a wholesale investment in Electropoises, which cure all diseases, and thus the policemen of Portland would be enabled to live forever and keep their feet warm meantime.

By the way, if the Electropoise could also be guaranteed to cure the disease known as the "itching palm," it would find a large customer in the Lexow Committee of this city.

* * *

Second-Hand Lamps

The following circular has been distributed by the Philadelphia Edison Company:

OLD LAMPS,
Eight to thirteen candle-power by photometric test,
16 CENTS EACH.

Cartage and packing added. The above lamps have been removed from consumers taking current from our station, but presumably have long life as they have been tested in actual use.

No guarantees. Sold only for use in isolated plants in this city.

Philadelphia is no doubt a peculiar town; it has even been said to be behind the times. But we doubt if users of electric lamps, even in Philadelphia, can be tempted to buy worn-out lamps at any price. The commercial instincts of Prof. Marks are evidently developed to a high degree.

* * *

THE bookkeeping expedients adopted by Mr. Joseph P. Ord in the days of the Edison General regime to protect his friends are matters of history. That he is still the same old Joseph Perfidious is shown by his recent rearrangement of the supply department to hide Mr. Lovejoy's unfortunate experiences as manager of the department. Under the Lead of supplies are now classed dozens of items that formerly were included in the item of plant, and thus the bulk sales of the department are recovering to a reasonable figure—on paper. We suppose that generators and motors will soon be transferred to the line of small supplies.

* * *

THE apparent improvement in the finances of the G. E. Company, if investigated, would no doubt assume a very different aspect. Losing money in its actual business in nearly every contract taken, it has been enabled to reduce its debt, buy bonds, etc., etc. One of the shrewdest men in Wall Street is our authority for the statement that this result has been accomplished by a pool among the Board of Directors, who have "as individuals" manipulated the stock market successfully for many months. Cordage, whiskey, and all the other wrecks would seem to be honest concerns in comparison with G. E.

* * *

AMONG many interesting documents introduced in the Boodle investigation at Toronto was an agreement whereby the Brush Company promised to pay an ex-alderman $4,000 for securing figures of all bids in advance of letting the contract and give the Brush Company time to change their bid.

These investigations cannot fail to be of immense benefit to all honest men in the trade and to the taxpayers of our municipalities. The death knell of the "special agent" is sounded, and the occupation of the "slick man" is gone. This has been, perhaps, the most important result of ELECTRICITY's campaign against corruption and bribery.

* * *

As Mr. B. E. Sunny's contract with the G. E. Company is nearing its end, he provides reason for a renewal of it by getting himself elected to the directorate of one of Mr. Yerkes's railway systems in Chicago. Foxy man!

* * *

THAT persistent old swindler, George B. Pennock, having milked New England pretty thoroughly, has moved up into the Northwest and will make a brief stay in Minneapolis. The length of this stay will depend altogether upon the number of fools in that city. He has been exposed so often that it seems like a waste of space to mention him, but he still manages to make a living out of his bunco game. He has nothing to sell, and there ought to be enough spunk in the local fraternity wherever he stops to expose his methods.

THE SITUATION AT SYRACUSE.

The Ring is Growing Too Bold.

We have already reported the refusal of the Syracuse aldermen to grant a franchise to the newly-organized Citizens' Company, and the public indignation aroused by this high handed proceeding.

The daily papers of Syracuse have now presented to them an opportunity to show to their constituency that they are doing what they claim to be, working conscientiously for the best interests of the city.

Whether the Citizens' Company should have a franchise or not is a subject on which there may be honest differences of opinion, and this is only an incident in the lighting situation in that city.

But this fact stands out clearly—any new company, with an investment of $200,000, could do all that the present company does with its capitalization of $1,550,000. The difference in necessary earnings is apparent, and the taxpayers of the city can easily see that the present company can not give them, service and charges considered, what any conservative new company could.

If the local papers get to the bottom of the electric lighting matter, they would be in a fair way to get at the bottom of several other municipal matters in which the city has been robbed for a great many years.

The political ring of that city is one of the mysteries which few understand, but which, after all, could be easily dislodged if the press had the courage to print the facts. It is more rapacious than Tammany, more corrupt than the

Brooklyn ring, and, to a greater degree than either of these, embraces the more prominent men in both political parties. For years it has had Syracuse by the throat, and has been enabled to sandbag every group of outside capitalists trying to do business in the city.

Probably this sandbagging process was never carried further than in the electric lighting matter. The first chapters of this story were given in Electricity two years ago: how two or three of the leaders in the old company froze out their associates by misrepresentations, buying up the stock at an insignificant price, then making a deal with Messrs. Kirk, Warner, Mowry, Barnes, etc., of the Onondaga Company, for consolidation.

The consolidated company was then capitalized for $800,000 common stock, and $750,000 bonds were issued. The plant represented perhaps an investment of $250,000. This investment, however, was not made by the Syracuse sharks, who never put a dollar into it. It was simply apparatus furnished by the T.-H. Company for which they took bonds.

Of the consolidated capitalization, Syracuse got the stock and the G. E. Company the bonds. The latter are divided now about equally between the United Electric Securities Company and the Street Railway Properties.

Although the plant did not earn an honest dollar last year, the Syracuse financiers paid themselves $40,000 in dividends, and are now, it is said, contemplating calling on the bondholders to put up more money. If this is not forthcoming a default in interest may be expected and another foreclosure.

The gang who are operating this scheme have little interest in the matter of giving Syracuse a good lighting service; they are chiefly concerned in locating money in some man's pocket and then getting their hand to the bottom of the pocket.

When will the wave of municipal reform reach Syracuse?

THE NATIONAL SCHOOL.

Prof. Gray's Views.

The following letter is self-explanatory:

> To the Editor of Electricity.
>
> **Dear Sir**: My connection with the National School of Electricity is simply honorary and advisory. No one ought to be misled, as the faculty was announced as honorary both in the public prints and in the prospectus of the School at the outset. If any have become active members since, the fact should be made known. If you will again refer to the dictionary ("Century") you will see that honorary means "merely to confer honor without customary requirements and obligations."
>
> Every one ought to know that there is a difference between an honorary and a teaching faculty.
>
> If any one has stated directly, or by inference, that my relation to the School is other than stated above, it is a mistake.
>
> I believe that the scheme is a good one and will help rather than hurt the regular schools of technology. I believe in education through every available channel; and if the boy cannot go to the school, the school ought to go to the boy.
>
> I believe also in fair play—that the two gentlemen who are the real promoters of the School should have every opportunity to vindicate themselves, and that judgment should be suspended till the evidence is all in.
>
> If the School is conducted legitimately and along philanthropic lines, then all good people should sustain it. If on illegitimate and fraudulent lines—as you seem to think—the School should still be saved by eliminating from it all that is vicious. If the former is true, I will be first to approve—if the latter, the first to condemn.
>
> Yours very truly, Elisha Gray.
>
> Highland Park, Ill., Dec. 3.

If any additional justification were needed of Electricity's treatment of the National School, Prof. Gray has supplied it. His statement shows that he has given too little attention to what the promoters of the School are doing and saying in their efforts to enlist students.

We have on hand all the available advertising matter used by them, including letters over the signatures of their various officials, one of which was reproduced two weeks ago.

Nowhere in the entire list is there any intimation that the faculty is an "honorary" and not a teaching faculty. And we would like to know what is an honorary faculty? Prof. Gray's definition of the word honorary is correct. But what precedent is there for an honorary faculty in any commercial educational institution?

In one of the School's pamphlets now before us, under the heading "Faculty" (not "Honorary Faculty"), appears a list of the honorable gentlemen who compose this faculty, with their respective connections and eminent positions.

Following this, on the next page, these statements are made:

> During the progress of the World's Fair, the Chief of the Department of Electricity received hundreds of letters from all parts of the country suggesting, in many cases urging, a course of lectures on Practical Electricity in connection with the department. As the great Exposition neared its zenith the letters and appeals became more urgent in tone, and the Chief of the Department *enlisted in the cause many of the experts in charge of exhibits.* . . . The subject was not allowed to die, however, and the Chief was besieged more strenuously than ever, and after the Fair was over the appeals took the form of a demand for a permanent substitute.
>
> In obedience to this demand, the Chief of the Electrical Department has secured the co-operation of the ablest men in the electrical profession and *so far as may be, the* ORIGINAL UNDERTAKING *will be carried out in a permanent and necessarily modified form.*

The emphasis is ours. What was the original undertaking? As stated by the officers of the School—instruction by electrical experts, who presumably have just been mentioned as the "faculty" of the School.

The chief stock in trade of the enterprise is the list of eminent names in this faculty. Every man who agrees to pay the tuition fee of $17.50 does so in the justifiable belief that he is to get the benefit of the knowledge, so far as possible, of all these worthy gentlemen. It is not, and could not be, explained to these prospective students that the faculty is an "honorary," not a "teaching" one.

The use of these names is a direct swindle upon the public, and as long as it is allowed to continue every man among them is directly responsible for the swindle. This is strong language, but it is the truth.

No effort has been made by the promoters to advise the public of the exact status of this faculty. Every effort has been made to conceal it; nay more, strong efforts have been made, and are being made, to convince the public that the faculty prepares the lesson leaves used. Mr. Edison and Prof. Gray are now on record in Electricity's columns, but Electricity reaches a small percentage of prospective students, who see only the misleading advertising matter of the School and have only the misleading statements of the promoters. A casual reference to what we have printed on the subject would show Prof. Gray that the false claims have been made and stoutly maintained.

In response to a request to put himself on record, Mr. Tesla has sent us the following:

> To the Editor of Electricity.
>
> **Dear Sir**: Yours of November 30 is at hand. There are reasons which prevent me from complying with your request, much as I would desire. Remember, if you please, that it is much easier to destroy than to build.
>
> Hoping that on some other occasion I shall be more fortunate, I am truly yours, N. Tesla.
>
> New York, December 3.

If Mr. Tesla and his associate members of this "honorary faculty" have no objections to lending their names to their friends to make money with, we would like to use them all as associate, advisory or honorary editors of Electricity. We could get 500 new subscribers in a month.

The Auer-Welsbach Burner.

In pursuance of our policy of endeavoring to lay the whole situation before our readers, Electricity has during the past week interviewed a number of the most prominent manufacturers of gas fixtures in and around New York, with the view of determining just what standing the Welsbach burner has among the trade which is best qualified to judge of its merits from an unbiassed standpoint. The result is as follows:

Opinions of Users of and Dealers in Light Fixtures.

Archer & Pancoast Manufacturing Co., 898 and 900 Broadway, New York. An officer of the corporation said that the Welsbach light was not kept in stock nor recommended to customers. He had never seen it in use with first-class gas fixtures, and though the stock of goods in his show-rooms included fixtures carrying nearly 4,000 burners, he knew that there was not a Welsbach burner in the assortment.

Mitchell-Vance Co., Manufacturers of Gas Fixtures, Broadway and 13th Street, New York, said: "We do not keep the Welsbach burner in our stock or show-rooms. A long time ago we permitted the agent for the Welsbach light to place six burners upon the desks used by our salesmen, but the light did not strike us as being the best for steady use and we sent for the agent to remove them, which he did shortly after receiving our request. It is sold by street peddlers from house to house in the tenement house districts. We have been informed that owing to the smallness of the demand for it, it is not kept by our competitors."

Iden & Co., Manufacturers of Gas Fixtures, University Place and 9th Street. A member of the firm said: "We do not carry the Welsbach burner in stock or show-room; we have samples and stocks of all approved gas burners, but no Welsbachs. The agency was offered to us some time ago, but we saw nothing in it for us and declined to conduct negotiations. A long time ago the Welsbach people opened a selling agency near us, but it was closed after a while, and what is being done to sell the Welsbach burner is not known by us. We keep all the really good gas burners that are fit for use, but we do not keep any which we do not commend for use under all conditions for stores, public and private buildings."

E. P. Gleason Manufacturing Co., Houston and Mercer Streets, New York, are the largest dealers in gas burners and appliances in the world. A member of the corporation said: "We have no Welsbach burners in stock or sample; many street peddlers who buy fittings and globes of us for saloon and marketmen's trade peddle Welsbach burners when the globe trade is dull; we have no means of knowing the extent of their sales, but do not think the burner is meeting with a ready market. We do not know anything about the Welsbach people's claims about saving in gas, but we do know that every burner rejected by the legitimate trade and sold by peddlers has been advertised as consuming less gas than the best burners, but the proof of the pudding is in the eating, and we find that the so-called gas savers are great wasters of gas."

Carpenter, Howard & Co., Manufacturers of Gas Fixtures, Fourth Avenue and 23d Street: "We have had but one customer who wanted a Welsbach burner; we purchased it for him, and our man adjusted it to a fixture and the mantel broke when he was burning out the cotton netting. Despite our explanation that the mantel was a defective one, we were obliged to pay fifty cents for another mantel, and that sale closed our experience with the Welsbach burner, which we do not show on any of our large assortment of chandeliers and brackets."

DREW & REESNER, Manufacturers of Gas Fixtures, Second Avenue, near 23d Street, New York. Mr. Drew said: "We do not keep or sell the Welsbach light, because there are so many kinds of superior gas burners which cost less money and last longer than the Welsbach light. A year or so ago many saloon keepers used the Welsbach, but the bother of keeping it in order, particularly in the summer months when flies and other insects got into the tube and 'queered' the mantel, made it unpopular, and nowadays of the 15,000 and odd saloons in this city there are not 200 that use the Welsbach. We take no orders for it under any circumstances, as it is hard to attach and always getting out of kilter, besides it makes no saving of gas, as far as I know, and it does not make as good an effect as globes or imitation candle gas lights."

[This trouble from flies and insects is one of extreme importance and one that we are glad to see adverted to. Places of public resort are the largest patrons of artificial light. They are in the summer time the most prolific breeders of flies, which, in spite of all care, are bound to get into the mantels and cause their destruction.—ED.]

B. GOETZ MANUFACTURING CO., Manufacturers of Gas Fixtures, West 18th Street, near Sixth Avenue, New York. A member of the company said: "We have as large an assortment of good gas burners as may be found in the United States, but we have no Welsbachs. Now and then men in the employ of the 'boomers' of that invention come in here and ask for them; at such times we agree to buy the burners on specified orders, but we never found one of these men who left an order. Sometimes they say, 'We will go elsewhere and buy of other gas fixture makers.' That does not scare us, because there is no gas fixture dealer in town who carries the Welsbach burner."

We next interviewed Mr. George B. Post, architect of the Cornelius Vanderbilt mansion, who informed us that gas was not used in the house at all; the ball room was lighted with electricity, and for certain effects wax candles were used for wall brackets.

The caretakers of Andrew Carnegie's and Wm. C. Whitney's mansions said that street "fakirs" peddling Welsbach burners came to the doors several times a week, but never made a sale. Electricity is used in both houses.

The stewards of the Metropolitan, Union League, Knickerbocker, Manhattan and Calumet Clubs said that Welsbach peddlers turned up from time to time and asked to place burners on trial. Permission was refused in every case. Gas is not used by these clubs.

From reports made to us by two gas fixture salesmen, whose routes are Broadway from 8th to 59th street and Fifth avenue from Washington Square to 110th street, there are few Welsbach burners in these two famous streets. In Sixth avenue, 14th and 23d streets, which are fashionable shopping districts, the Welsbach light is classed with appliances beneath the notice of first-class merchants.

Opinions of Prominent Merchants.

B. ALTMAN & CO., Retail Dry and Fancy Goods, New York: "Some time ago we allowed an agent of the Welsbach people to put on a few burners, but the light was of a yellowish glimmer, trying to the customers, and unsuitable for a proper showing of colored fabrics, so we decided not to purchase the burners, which were removed. We do not know whether any gas was saved as we made no tests."

TIFFANY & CO., Jewelers, New York: "We have seen the Welsbach burner, but have declined to purchase it. We decline to state our views of it."

W. & J. SLOANE, Carpet Merchants, Broadway and 19th Street, New York: "There is no truth in the statement that we have adopted the Welsbach light and cut off electricity. We have no Welsbach lights."

CONSOLIDATED GAS LIGHT COMPANY, New York: "There is no truth in the statement that we are pushing the Welsbach burner; we do not recommend gas governors, gas stoves or burners except when our advice is asked, when we refer our friends to dealers in gas supplies. We do not know anything about the Welsbach Light Company's assertion that the use of their burner effects an enormous saving of gas; we do know that so-called gas-saving appliances are frequently sold hereabouts with forged letters of recommendation from gas light companies. No one can get a good light without burning a proper amount of gas."

L. DELMONICO'S, New York: "Several years ago one of our patrons, who was a part owner of the patent mantel Welsbach light, induced us to use a few in our café. We abandoned them after a short trial which demonstrated the reverse of the claims set up by the vendor."

HILTON, HUGHES & CO., successors to A. T. Stewart, Dry Goods, Broadway, 9th and 10th Streets, New York: "Just before we remodelled our establishment we were approached by the agents for the Welsbach light, who made a liberal offer which we considered for a while, and not being able to satisfy ourselves that the light was economical and efficient, we concluded not to adopt it, and decided to use the incandescent electric lamp both for show windows and general use throughout the building."

The storekeeper for the supply department of the Manhattan Elevated Railway said: "We have no order out with the Welsbach Light Company for their patented burners; we have seen it, but are not disposed to use it."

MR. F. A. GOELTZ, a prominent jeweler and optician, of 377 Third avenue, New York, is one of the largest importers and retailers of fine diamonds in New York, and has the patronage of nearly all of our famous actresses and operatic stars. We called upon him for the purpose of interviewing him about the Welsbach lights which were recently installed in his establishment. Mr. Goeltz said: "I am certain that the Welsbach light is about the poorest light for my business, as it yields a greenish and yellowish light which casts a scummy appearance on my diamonds and gold jewelry. I think I lost several customers this week who strayed in to look at goods by gas light and went out without purchasing anything. Several of my old customers have noticed that the Welsbach light makes me look bilious, and I have noticed that several ladies who came at night looked at themselves in my mirrors when trying on ear-rings, and said that the new light made them look as if they were suffering with jaundice. There are other bad features in the Welsbach light—for instance, it is trying to the eyesight of myself and employees, and throws the light upon the ceiling instead of where it is wanted, on the goods and walls. I am experimenting with other gas lights, and consider the Welsbach the poorest kind experimented with. I have written to the Welsbach people to remedy the defects (which, in my opinion, cannot be remedied) or remove the lights. ELECTRICITY is permitted to use my name in this matter."

On the Bowery.

When we told the representatives of the Welsbach light that their burners were conspicuous by their absence in first-class stores and residences in New York, and asked where their light was displacing electric lights, we were told to visit the Bowery and see for ourselves that the Welsbach was the most popular light in that famous street. We decided to make a store-to-store canvass of the Bowery and interview several prominent personages whose names are famous wherever the Bowery is known. We found the number used there insignificant as compared with other lights. Many merchants and householders told our reporters that they had tried and discarded the Welsbach light. A well informed employee of the gas company at Bowery and Grand street said: "The Welsbach burner is played out for show window purposes in the Bowery district." Several merchants who have it on fixtures do not light it but depend upon other lights; other merchants are holding the Welsbach subject to the orders of the men who placed them on approval.

Among the merchants whom we interviewed were Casperfield & Co., who always have $2,000,000 worth of diamonds in their windows and showcases. Mr. Casperfield said: "We have spent thousands of dollars for patented gas and electric lights, and for a while we tried the mantel gas light, which we found unreliable and worthless for lighting our goods. We abandoned gas and are using electric lights exclusively and would not take 'Welsbachs' as gifts."

"The Six Little Tailors" said: "It is generally admitted that we have the handsomest tailoring establishment in the city, and at night it is brilliantly illuminated with electric lights. We were offered a lot of Welsbach lights free of charge, but declined the offer with thanks, as the effect of the light upon our goods would have been unsatisfactory. We want the best light going and we have it."

"Simpson," the pawnbroker, said: "Welsbach burners don't go here—not on your life; electricity is good enough for me."

"The Original Harris Cohen" said: "We have no time for the Welsbach burner; it takes two men and a boy to monkey with it in a large store like ours. We tried it last year and gave it the g. b."

"Callahan the Hatter" said: "We use bat wing gas burners under globes and electric incandescent lamps in stalactites, using both systems of lighting every night. We do not use the Welsbach light, because it throws hideous colors upon goods and decorations."

The Theaters Dare Not Use It.

Harry Miner said: "I would not use the Welsbach light in my theater because it throws such ghastly colors."

The gas engineer of the Grand Opera House, New York, said: "There is no truth in the report that I have invented a scheme to throw a death color upon *Juliet* or *Ophelia* with the Welsbach gas light; no doubt the effect would be good, but the trouble of rigging it up for a few minutes would not pay. No, we have no Welsbach burners in the theater, nor do I know a theater in the city where it is used."

The Damage a Rat Can Do.

A rat at Baltimore played havoc in the Brush Electric Light Works at Baltimore late on Thursday night of last week. About midnight, the switchboard and the connecting wires in the works were ablaze, and when the display ended the entire board was a wreck. It was not until after an investigation that the explanation presented itself.

A rat in skipping along from one brass terminal to another had short circuited the wires of one circuit. When found the rat was wet and the body rigid, as if frozen in the act of stepping across from one brass piece to another. The remains of the rat are preserved at the works. So lifelike is the attitude of the rat that at a little distance one would think it a live rat in the act of jumping.

DIRECT CURRENT MOTOR AND DYNAMO DESIGN.*

BY GANO S. DUNN.

I wish to refer to-night to several features of direct current motor and generator design, and not to pretend to cover the whole subject, and I trust this will not be without interest to you.

The first point I wish to bring out is how very imperfect are our means of rating electrical machinery. We have good means of rating other machinery, but we do not have good means of rating electrical machinery. The steam engine is rated by the diameter of its cylinder and length of stroke and its speed. It is not sold by horse-power, because an engine which could develop 100 H. P. at $\frac{3}{10}$ cut-off would develop 200 H. P. at $\frac{6}{10}$ cut off. In electricity the problem is similar, but we have no way of rating motors by the diameter of cylinder and length of stroke as they have in steam engine practice, and we are continually suffering on this account. Water wheels are not sold by horse-power. You do not buy a 50 H. P. water wheel; you buy a 28-inch water wheel and run it at so many feet head and then figure out how much power you can get from it, and if it is not enough you buy a 30-inch wheel.

The limits of loading an electric motor are really two only, namely—you have reached the load of a motor when it begins to heat so much that it is dangerous to continue to run it, and you have also reached its limit of load when it sparks so badly that if you run it longer it will destroy its commutator. There are builders to-day who build a motor which will have a very high efficiency at one third load but which will spark if it is overloaded, and there are other makers who build a machine which has not a high efficiency at light loads but which will stand three and four times normal load without sparking. Now both of those motors are listed in the catalogues, are charged for and are known as, let us say, 10 H. P. motors.

If you buy a 10 H. P. motor without knowing something about these facts it is possible that you will be very much mistaken. If it is agreed that we should call a motor that runs at about 6 H. P. but is capable of running at 10 H. P. continuously without dangerous overheating, but will never be called upon for more than 10 H. P. —if we should agree to call such a motor a 10 H. P. motor, very well. But then we ought to call the motor which is used in crane service, which is called upon for 30 or 40 H. P. for periods of ten minutes at intervals, something more than, or different from, 10 H. P., and the builder ought not to be obliged to make one motor fill one user's requirements and another user's requirements when their requirements differ so much. Suppose we sell two 10 H. P. motors to ordinary customers. We may hear a report from one of them that this motor is not a good motor, it does not give 85 per cent. efficiency at one-third load; while the other one will say this motor is not a good motor, it sparks very badly when loaded to 300 per cent. of its normal load for a few moments. In view of these facts horse-power is not a fair way to rate machines.

The lines between these kinds of motors are not so distinctly drawn as I have pointed out, but for the purposes of illustration I have shown here two curves, A and B, Fig. 1. A is the curve of a motor of the kind first mentioned above. It is expected to run at 6 H.P. average, can give 10 H.P. all day long if you require it, but must not give any more, and has a very high efficiency at light loads. Such a motor is an ordinary power motor for running a printing or machine shop. The other motor, whose curve is shown at B, is a motor whose efficiency at light loads is very low; it is not much more than half the former. But its efficiency at full load is exactly equal, and at overload is even higher than this other motor. Motor B is much superior for its work to the former motor because whenever it does run it runs at three times its rated load, and motor A, whenever it runs, as I will show later, runs at only one-third its rated load. Put motor B on the load that A is built for, and A on the load that B is built for, which is what you are likely to do, and you will not secure the best results.

This A curve machine is the type of ordinary power motor running machinery by a belt. The B curve machine is a type of railway motor or motor for operating cranes, or for other intermittent and very heavy work. These two conditions affect the design of a motor very much, and the way they affect it is this: At the point C both motors have the same efficiency. That means that the losses in both motors are equal. But why, then, does curve A differ from curve B? The difference is in the distribution of the losses. The losses in a motor are of two kinds, fixed and variable. The fixed losses are the losses due to field current, hysteresis and eddy currents, brush friction and bearing friction. The variable losses are the losses due to armature resistance and the losses due to commutation. Now motor A is a machine with a small magnetic circuit using comparatively few lines of force. Therefore the wire that is wound around this magnetic circuit to keep it excited need not be very great and consequently will take but a small amount of current to energize it. The iron in the armature will be small in quantity, and therefore the hysteresis and eddy currents will be low and the bearings will be rather light, because this motor is never called upon for more than rated load. Therefore the fixed losses are light. The variable losses, such as armature resistance and commutation losses, may be high in this machine without detriment. The reverse of these conditions is true in machine B. These points are of great importance but they have not received attention.

As a result of tests made on about 200 power motors, at the instance of Mr. H. L. Lufkin of the Crocker-Wheeler Company, it was found that these 200 motors on actual commercial circuits did not average one-third of their load. The readings were taken in this manner: It is customary whenever a motor is installed to put in a meter that measures the current taken. Now if this was a 10 H. P. motor and ran ten hours per day it ought to have 100 H. P. hours for every day it runs. The meter readings were taken and the average was between 25 and 30 per cent. of the power that the motor could have given according to what was stamped on its name plate. Now if we build a motor with the kind of an efficiency curve B, and use it for a purpose such as I have just spoken of, where a motor averages only one-third load, it is practically equivalent to taking a motor of only one-half the efficiency.

Another thing with regard to the rating of motors is the speed. Other things being equal a high speed motor is cheaper to build than a low speed one. It is a smaller machine operated at greater activity. If brought to the same speed it would have less power. A motor, to be compared carefully, ought to have these points determined:

1. At what portion of the load does it commence to spark?
2. At what portion of its load will its temperature rise abnormally?
3. What is its efficiency at various points?
4. At what speed does it run?

Reduce all these things to a common basis and you have a fair method of comparing motors.

Too much importance has heretofore been attached to full load efficiencies. Motor engineers boast that their machines have 90 per cent. efficiency and some other maker's machines have only 88 per cent. efficiency. They speak of the highest efficiency that the machine is capable of, or of the efficiency of which they are most proud. Now that may not be the efficiency which the customer wants to know. There are many cases where a motor of 85 per cent. efficiency would take less current to run a printing office than a motor of 90 per cent. efficiency, for this reason: At point D, Fig. 1, is a motor of 90 per cent. efficiency. But the printing office runs at only about one-third of the power of its motor, and would therefore realize the efficiency at B; whereas at point E here is a motor which has 85 per cent. efficiency and if the printer bought that he would realize the efficiency at A, which is much higher than that at B.

The next feature to which I wish to call your attention is the most recent methods of winding. I cannot go into this more than slightly, but it might be well to give some idea of what they are. In winding bipolar machines windings are all on the same principle—they are two-circuit. As the current leaves the brush, in diagram A, Fig. 2*, half goes down one side of the armature and half down the other and joins the bottom brush and goes out. Now there is not much room for modification in that winding. It can be made ring or drum, and that is practically all. But when we come to the multipolar machines there is a great variety of windings which we can use. If we imagine B, Fig. 2, to be a four-pole machine, with the armature a ring in which the wire is wound around and around, then the current may be taken off this armature by brushes P, N, P, N. These are the field magnets of alternate polarity and each field magnet generates a portion of the total current. This is called four-circuit, because there are four circuits from which the current is collected in the armature.

FIG. 3.

The earliest multipolar machines were wound in this fashion, but there are some objections to it. If one pole is stronger than its neighbor, then when it sends its current to be collected it will be under greater pressure than the one coming from the other pole and if there is sufficient difference will neutralize it and send a reversed current through its winding. This causes heating, diminishes output and reduces the efficiency of the machine. Now it is very easy for one magnet to become weaker than another one in an actual machine. Suppose, for instance, that the bearings of the machine wear, the armature will settle down and will be nearer these bottom magnets than it will be to the top and they will make stronger currents than the top ones will. Then, again, if the windings on the magnets are not very carefully made and one has a few more turns of wire than the other, it will be stronger, and there are a great many ways that the effect of inequality of electromotive forces generated under the poles will produce very bad results.

To overcome this windings were invented which are called two-circuit windings. The object of the two circuit winding is that the wire shown in D, Fig. 2, instead of going along always under the weak pole, between every section, cuts across and goes under a strong pole and comes back, and the winding under the strong pole cuts across every other section to the weak, so that by the time the brush is reached the windings have each had acting upon them both the weak and strong poles and the result has been to make equal electromotive forces and produce no trouble.

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*Lecture delivered before the New York Electrical Society November 27, 1894.

*From "The Practical Management of Dynamos and Motors," by F. B. Crocker and S. S. Wheeler.

In actual windings these connections are not made on the armature in this form of two-circuit winding but are made inside the commutator. This commutator is of the kind shown in Fig. 3. Every bar is connected to the bar directly opposite to it by a bird-wing form of connector. The connector is shaped in the following way: It starts down, goes over in the form of a bird-wing, goes inside about an inch and after it has reached the underlayer of windings it makes the rest of its circuit until it gets down to the bottom. The armature is wound the same as a four-circuit armature, but when its ends are put into the commutator these cross-connectors have the effect of making the alternate poles generate part of the electromotive force, as shown in the diagram. The armature I have described is but one kind of a two-circuit armature, but there are other kinds that are used about as much. The other kind of armature is not wound in ring form but is like that shown at E in Fig. 2. Now the armature I have just described was wound as a coil, which was connected to another on the other side. There will be no short circuiting due to unequal voltages. [A model of this kind of an armature was exhibited.] I will not describe further the two-circuit windings since they are all on the same principle.

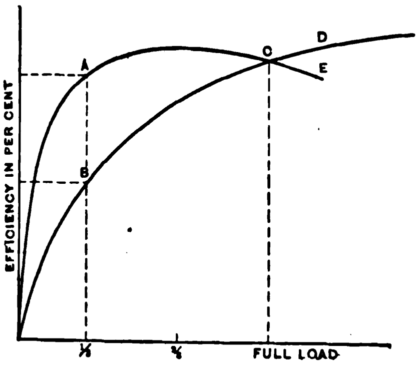


FIG. 1.

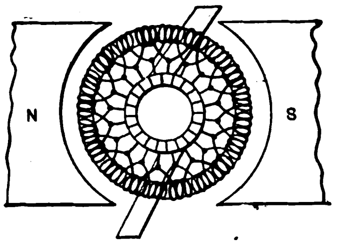


FIG. 4.

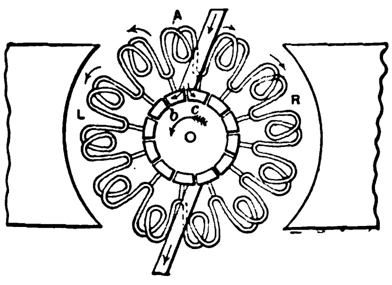
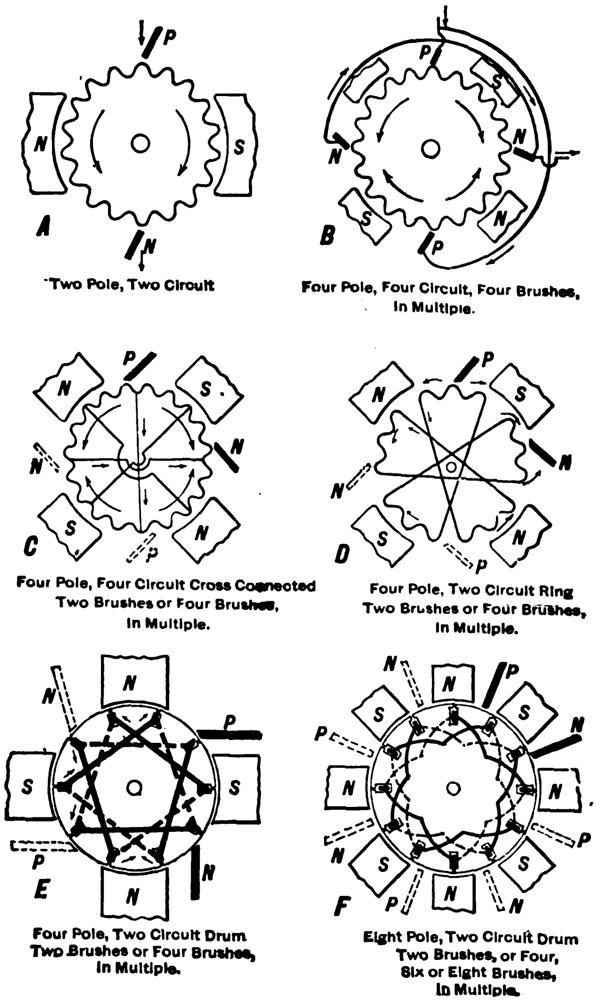


FIG. 5.

There is another advantage in the two-circuit winding besides stopping the interaction of parts of the armature against itself, and that is, that for very high voltage machines if we had a four-circuit armature, as previously described in B, Fig. 2, the wire under each pole would have to generate full voltage. In a 500-volt machine each pole would have to generate 500 volts, so that the little current it contributed would be at the same pressure as the other current. That necessitates fine wire. If there are only two circuits each pole contributes only half the voltage and the wire may be of twice the size, which is a very important consideration. When we get into very large machines, however, then the wire gets too big for us to handle in two-circuit machines and we go back to the four-circuit windings.



Two Pole, Two Circuit

Four Pole, Four Circuit, Four Brushes, In Multiple.

Four Pole, Four Circuit Cross Connected Two Brushes or Four Brushes, In Multiple.

Four Pole, Two Circuit Ring Two Brushes or Four Brushes, In Multiple.

Four Pole, Two Circuit Drum Two Brushes or Four Brushes, In Multiple.

Eight Pole, Two Circuit Drum Two Brushes, or Four, Six or Eight Brushes, In Multiple.

FIG. 2.

The next form of winding that I wish to describe is one in use by the General Electric Company and known as a double winding. The reason for a double winding is this: It is a rule among electricians that the voltage between any two bars of the commutator must not be greater than, say, 20 volts. If it is much greater in a large machine any little accident—a piece of carbon—would make a flash, and, once started, the whole commutator would blaze and there would be a short circuit and great trouble. To keep that down the voltage between the bars must be kept down low.

The voltage generated by a machine is proportional to the size of the magnets and the number of the windings. Now as the magnets get large the windings need be fewer in order to generate the same voltage. As our machines get larger and our magnets get larger we need only a few turns of the heavy conductors on the armature to give us, say, 110 volts for lighting. We soon reach the point where, say, 10 turns on the armature would be enough to give us 110 volts. That would give us ten sections to our commutator, and as half the sections are on one side and half on the other, that would give us only five sections of the commutator among which to distribute 110 volts, and that would be more than our limit. Now, what are we to do? We cannot increase the number of turns because we would get more voltage than we want. We cannot decrease the size of the magnets because then we would have sparking and armature reaction and other troubles. There are two things for us to do—one is to use the multipolar machines, which have a number of small magnets each contributing to the total current, or to use the form of winding shown in Fig. 4. In this diagram there are ten coils and ten commutator bars belonging to each winding. When we use the windings in conjunction we have the voltage due to ten coils and the commutator bars due to twenty, and that is achieved in this manner: The windings are wound just as if they belonged to two different machines; one winding is entirely disconnected from the other and it generates, say, its 110 volts with its few commutator bars—too few to be used by itself. But when we put these two windings together then we have still 110 volts, but we have double the current, because each of the windings contributes some, and we have double the number of commutator bars. Now that is in reality just like two dynamos. The brushes are made so wide that they cover at least two of the commutator bars, so that each winding is free to contribute its share of the current, no matter what the position of the armature is. We have shown this for a bipolar machine. But if we go into multipolar machines we will soon reach a size where we are again face to face with it, and we would have to increase our poles and would soon catch up with this difficulty again, and this method of double winding is an excellent one for overcoming it. It has also the advantage that the collection of the brush is better.

(To be continued.)

Direct Conversion of Light into Electricity.

At the last meeting of the Société Internationale des Electriciens, held on November 7, M. Ch. Maréchal showed experimentally, by means of an electro-chemical actinometer, that luminous energy is transformed into electrical energy mechanically—available even at long distances—not through the calorific or chemical power of the light, but by virtue of a third force, which the writer calls actinic force.

This transformation is effected in all the divisions of the spectrum, but depends on the coloring matter employed for sensitizing the plates of the actinometer, the sensitiveness of which is so great that the light of a candle at a distance of some meters produces effects that are as clear as they are instantaneous.

After discussing certain applications to telegraphy and photography, M. Maréchal in an hypothesis which, though bold, is based on facts ascertained by observation and experiment, shows once more the close connection between electrical and luminous phenomena; then he showed the intimate relations existing between solar light and the great natural phenomena, such as terrestrial magnetism, the different variations of the magnetic needle, the aurora borealis, earth currents, etc.

This would seem to mark the beginning of a new epoch in optical physics and to open new avenues of investigation which may lead to the most important results. While this brief notice, which is all we have at present, suggests nothing incompatible with our present beliefs or the teachings of Maxwell, it seems likely to give those teachings a new significance and to give them a concrete value that they have not heretofore possessed.

Frank White, of Meriden, Conn., son of J. H. White of the Wilcox & White Organ Company, is the inventor of an electric motor which is now being used in Oliver Ditson Company's store at Boston to run an organ. It is an interesting piece of mechanism and may be applied to the largest parlor organ. The bellows regulates its own speed.

THE ELECTRIC LIGHT IN PHOTOGRAPHY.

The growing interest in and application of the electric light in photography will render the following letter, contributed to *Anthony's Photographic Bulletin*, apropos. Mr. George G. Rockwood is one of the old-time photographers of whom very few now remain and of whom still fewer have made a financial success of the business. That he has made a success of it both artistically and financially is doubtless due to the fact that he has at all times kept himself abreast with the times. With the advent of electricity he was among the first to apply it successfully to photography, and has since done much to perfect its utility. In proof of the sound basis for his enthusiasm he shows a photograph of Miss Florence Rockwell, which we reproduce herewith. It loses much in reproduction by the half-tone process, as all photographs do, but enough remains to show the extreme beauty of his results.

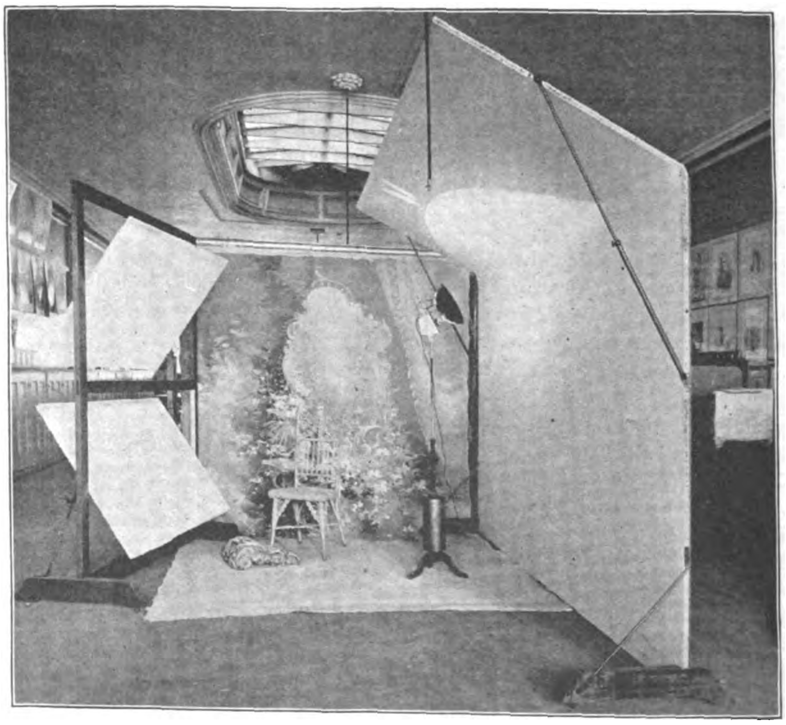
From a Photograph of Miss Florence Rockwell.

The subject is a most fortunate selection both in personality and pose, and would do justice to any process; and while we are discussing the process by which the results were obtained we feel that our attention is quite as much attracted to the subject as to the process.

Mr. Rockwood's letter is as follows:

THE "ELECTROGRAPH."

The days of the skylight are numbered, and with it passes away the climbing of stairs and many of the disagreeable objections and traditions of olden times. The great "reformation" will be accomplished by the electric light. In fact, in the language of the troubled Frenchman, "*c'est un fait accompli.*" I have been the most antagonistic of all as to the final victory of electric light, and it is a rash man who will put himself on record as favoring the electric light in preference to daylight; but in my thirty-eight years as a photographer I never yet made in one day thirty negatives so beautifully lighted, so uniform in exposure, and possessing so many good qualities as those of Miss Florence Rockwell, whose "electrographs" illustrate this month's *Bulletin.* The average exposure was about a second and a half, as far as it was possible for Mr. Hillman and myself to determine, or about as quick as a bulb could be pressed and closed with care. Every picture was fully timed, and I see nothing that would indicate to the layman, amateur or expert photographer that they were not made under a soft ground-glass skylight in daytime and under the most favorable circumstances. The tremendous expense of building skylights, and the fact that they must be constructed with a certain relation to the points of the compass, has proved a serious handicap to the photographic profession. If I should start business anew to-day, I should give no consideration to the fact of a northern, southern, eastern or western exposure, but should put in my electric lights and work with them, with a thorough conviction that the best work of my life was to be accomplished in this way. I feel some hesitation in declaring that the electric light is better than daylight, but for many reasons I feel convinced that it is. It is more concentrated, and yet can be diffused as much as is desirable. From this fact a soft light may be put upon the head and a more accentuated light upon the draperies, and results obtained which would be extremely difficult under a daylight exposure. I intend hereafter to supplement my daylight exposures at all times after 3 o'clock and through the very busy season up to 10 o'clock at night. I shall defy any layman or expert to tell under which light the pictures were made, unless it be that the superior quality of the electric lighting will be noticed. It is well known that I do not go off at half-cock on new things and never ride hobbies, but in this system introduced by Messrs. Anthony I seem to see a great future. The wizard of Menlo Park is getting the best of Apollo, the sun god!



Electrical Photograph Apparatus.

By permission of the publishers of *Anthony's Photographic Bulletin* we are also enabled to reproduce a cut showing the apparatus by which these spendid results are obtained. No further description is necessary than to state that when the light is reflected from a 12-foot screen and side reflectors, as shown, the time of exposure is the same as with good daylight. By moving the side reflectors any light effects desirable are attainable and with the advantage over daylight that having once determined the proper time exposure it need never vary as in daylight for the same results.

An Electrical Letter Box.

An electrical letter box which gives the alarm when the postman opens it is a recent invention. The box is placed at the street door and is connected by a wire with the rooms above, and when the lid is raised to place a letter therein the alarm is given. It is impossible for a letter to lay in the box unnoticed. The act of opening the box to insert a letter starts a very simple clock motion and the circuit is closed, or rather the commutator turns with the closing of the box. The commutator revolves continuously in one direction, so that there is nothing to get out of order.

The Chemical Theory of Accumulators[*]—VI.

BY E. J. WADE.

Returning now to the case of ordinary storage cells, it becomes easy to see how the reactions just considered are modified by the introduction of lead electrodes; and the explanation takes the same lines as those already laid down by Dr. Armstrong and Mr. Robertson, who in their turn largely base their explanation on Prof. Marshall's researches into the formation of persulphuric acid and the persulphates.

To consider the positive electrode first. At the end of the discharge this consists very largely of lead sulphate, and the free sulphion first enters into combination with it to form lead persulphate [$Pb(SO^4)^2$].

$$PbSO^4 + SO^4 = Pb(SO^4)^2,$$

which then reacts with two molecules of water producing lead peroxide and normal hydrogen sulphate.

$$Pb(SO^4)^2 + 2H^2O = 2H^2SO^4 + PbO^2.$$

At the commencement of the charge, when a large quantity of lead sulphate is present, no doubt nearly the whole of the sulphion is absorbed in this way, and only a small percentage reacts with the hydrogen sulphate to produce hydrogen prosulphate as shown above. The latter reaction will, however, begin to increase in amount after a certain point has been reached, because, as the lead sulphate is gradually converted into peroxide less and less remains for the sulphion to act upon.

When practically all the lead sulphate is reduced, and the electrode thoroughly peroxidized, it cannot be further attacked, and the whole of the sulphion then goes to form persulphuric acid, with immediate re-decomposition and liberation of oxygen; in fact, the usual phenomena attendant upon the electrolysis of dilute acid with platinum or other unattackable electrodes are observed.

It can now be seen that the amount of the difference between the curves of charge and discharge E. M. F. in Fig. 2 is really a measure of the proportion of persulphuric acid that is being produced at different periods, although no data are available that will enable it to be stated in absolute figures. As just explained, for the first two thirds of the charge it remains fairly constant, then it goes on increasing till the cell is fully charged, and even after that it goes on increasing till a point is reached when the persulphuric acid decomposes just as fast as it is formed. The greater the density of the charging current the higher will the E. M. F. rise before equilibrium is attained, and this is exactly what in practice is found to occur.

The chemical actions that take place at the negative electrode present very little difficulty and are easily followed. Hydrogen in a "nascent" or highly active condition is liberated, and exerts a powerful action on the sulphate or other salts of lead that may be present, reducing them to the metallic state with the liberation of hydrogen sulphate.

$$PbSO^4 + H^2 = Pb + H^2SO^4.$$

Towards the end of the charge, when the reduction is nearing completion, the surplus hydrogen commences to pass off in a gaseous state and in rapidly increasing quantities. Indirect evidence regarding the nature of some of the chemical changes that take place in storage cells may be derived from an examination of the variations in temperature during charge and discharge. In both cases, provided the whole of the reactions were absolutely electrolytic, no heat should be generated except that due to the electrical resistance of the cell, and any rise of temperature, beyond what can be accounted for in this way, must be ascribed to wasteful unelectrolytic heat producing actions, including what is generally known as "local action."

Unfortunately the data bearing on this question is extremely meagre, being comprised in a few experiments of Messrs. Duncan and Wiegand, and of Messrs. Ayrton, Lamb and others. Curve *a*, Fig. 3, is taken from the published researches of the latter gentlemen, and shows the rise in temperature of a cell when being charged, while curve *b* shows the fall in temperature during discharge. Upon calculating out the amount of liberated heat to which this rise in temperature corresponded, it was found to far exceed that due to the electrical resistance of the cell, and in fact it was equivalent to 17 per cent. of the total amount of energy put into the cell while charging. Thereupon the authors make the following very practical suggestion, which is best given in their own words: "In order, then, to improve accumulators, what has to be especially sought for, and, if possible, then prevented, is that chemical action which, in the case of the cells we were using, keeps the mean temperature of the cells about 0·7° C. above that of the air. This chemical action is very possibly quite distinct from the reversible one which accompanies the storing up of the electrical energy and its subsequent liberation."

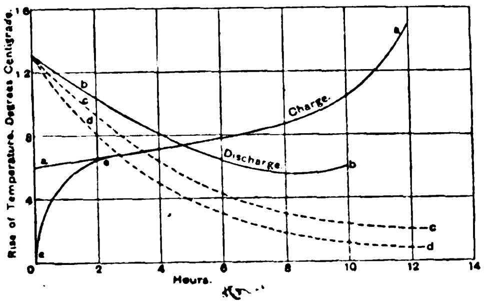


FIG. 3.

Now, all the evidence seems to be in favor of the action in question being the generation and subsequent decomposition of persulphuric acid, which has just been dealt with at some length in explaining the charging reactions, and in fact if this does occur it follows as an absolute necessity that it must be accompanied by an evolution of heat just such as is actually observed. It will be noticed how comparatively slowly the temperature rises during the first two-thirds of the charge when, as has been shown, the production of persulphuric acid is small; how rapidly it rises during the last third of the charge, and how, as might be expected, it still goes on rising after the cell is quite full, proving beyond a doubt that it is not due to any reactions taking place in the electrodes themselves.

Unfortunately, there does not appear to be much probability, or even possibility, of doing away with the wasteful reaction in question, as it appears to be a fundamental one involved in the electrolysis of dilute acid under any circumstances.

No conclusions can be drawn from the discharge curve *b* without the rate at which the cell would cool if no heat were being generated is known, or, better still, the rate at which it would cool if the only heat generated were that due to the passage of the current through the internal resistance of the cell. These are given respectively in curves *c* and *d*. It is now at once apparent that a gradually increasing generation of heat is taking place throughout the whole of the discharge, but that at no period is it as much as that generated while charging. The amount is far too small to be due to any of the main discharge reactions, being merely heat producing; in fact, that so little heat is generated is one more proof of the impossibility of any such action. Another explanation that at first sight appears possible is that it is caused by the gradual breaking up of the hydrogen persulphate and hydrogen peroxide left over from the previous charge, which in these experiments only ceases immediately before the discharge begins. But, if this were the cause, the generation of heat would be greatest at first, and then gradually die away, instead of which exactly the opposite takes place.

It appears more probable that the heat is really due to a cause which was pointed out in the fourth article of this series as certain to produce such an effect—namely, imperfect diffusion. Every practical cell, however well designed, must suffer to some slight extent from this cause, and moreover, as the discharge proceeds and the active material becomes more and more choked up with sulphate, it will become more and more marked; and this is precisely what happens.

While the amount of heat liberated during the discharge does not under any circumstances appear to be large, the remarkable observation has been made that sometimes there is actually an *absorption* of heat during this process. In some of Prof. Ayrton's experiments the temperature of the cell at the end of the discharge, instead of being 0·6° above that of its surroundings, as shown in Fig. 3, had dropped to the same level or slightly below the surrounding temperature, and, it will be seen from curve *c* that, even if the only heat generated were due to the cell's internal resistance, its temperature ought still to be 0·2° in excess; this represents an absorption of heat. Unfortunately, beyond the temperature at the commencement and the end of the discharge, no other or intermediate readings were taken, so that it is impossible to say what was the form of the discharge curve in these instances, or whether the heat was being absorbed throughout the discharge. From the nature of the corresponding curve for the rise of temperature during the charge that followed (see curve *e*, Fig. 3) it would appear probable that this was not the case, and that it only began to take place towards the fag end of the discharge. If this is so, it would imply that the effect must be due to some reactions which commence about that time, and it is possible it may be in some way connected with the slight formation of lead peroxide that is sometimes observed to take place at the negative electrode. Great difficulty has always been experienced in explaining this phenomenon, and in deciding where the whole of the energy necessary for its accomplishment can be obtained from, but on the supposition of an absorption of heat the phenomenon becomes more explainable. Lead peroxide could not be produced without the formation of an equivalent quantity of persulphuric acid, and it has been already stated that this compound does absorb heat in the process, while the amount of acid generated would form too small a percentage of the bulk of the electrolyte to undergo immediate re-decomposition and give up its heat again.

The usual explanation of the cooling of the cells during discharge is to say that just as heat is generated when water is added to acid, so heat is absorbed when the acid is withdrawn from the water again; or, more vaguely, it is ascribed to the dissociation of fresh molecules of acid necessary to replace those used up; but these actions form part of the electrolytic reactions of the cell and help to determine its E. M. F., and they cannot be used over again, therefore, to account for the cooling effects.

(Concluded.)

Tom L. Johnson, of Cleveland, Ohio, has begun a suit in equity in the United States Circuit Court, Brooklyn, N. Y., against the Brooklyn Heights Railroad Company. He claims damages for the use of a trolley fender which infringes on a patent issued to him June 16, 1891. He also wants a mandamus preventing the company from using the fender.

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[*] From "The Electrician," London.

An Electro-Medical Fraud—IV.

ELECTROPOISE, GROSSEST OF THERAPEUTIC HUMBUGS.

"The one discordant note in all this great display of genuine scientific and engineering work was found in the fact that in this same temple of science—in Electricity Building itself—naked imposture, quackery in the form of so-called electrical belts, hairbrushes, insoles and what not, had obtained a footing and stalked forth unabashed. No words of condemnation can be too strong to be applied to the parasites who, in the guise of healing and benefaction, succeed in extracting perhaps the last money from the sick and suffering for their worthless trumpery."—PROF. ELIHU THOMSON, in the *Engineering Magazine*.

On December 6 Daniel F. Beatty, a well-known manufacturer of organs, was convicted of the fraudulent use of the mails. It was proved that one Coley had been induced to buy, through circulars sent through the mail, an organ for $50 which Beatty represented was worth $100. Experts declared the organ was not worth $15.

The misrepresentation and fraud involved in Beatty's organ business were reprehensible and have been judicially declared criminal. But how much more despicable is the fraud involved in the sale of such an instrument as the "Electropoise"?

The $15 organ could injure no one, could result in no harm except to the business of honest competitors.

The "Electropoise" might easily result—no doubt has in many cases resulted—in the death of the patient trusting in its merits and misled by the fraudulent representations of its vendors. The latter, and every man who has aided in any way the sale of these instruments, including the publishers of papers printing their advertisements, are guilty of worse things than fraud or abetting fraud.

The vendors are guilty of a crime which is only one degree removed from homicide, and the testimonial-givers and publishers of easy conscience are guilty of giving aid and comfort to the active criminals. We hold that this assertion is beyond argument.

If the "Electropoise" could do *some* of the things claimed for it, the man who will recommend it, and sell it, as its promoters do, to patients attacked with pneumonia, yellow fever, cholera morbus and other radical diseases, would still be guilty of infamous crime.

ELECTRICITY'S warfare against these quacks has only begun, and publications like the *Review of Reviews*, *Christian Nation*, *Literary Digest*, etc., who have persisted in carrying their advertisements after having the swindling character of the whole business clearly pointed out to them by an authority, will find it rather unpleasant to explain to their reputable advertisers why they are willing to advertise frauds, humbugs, quacks and criminals at the same rates and on the same pages with good books and other legitimate advertising notices.

The "character" of all these swindlers is illustrated by the career of "Prof." Wilson, the inventor and proprietor of "Actina." Convicted of malpractice in Philadelphia, he wore the convict's stripes in Pennsylvania; he came to New York and was again convicted of crime in the sale of a fraudulent remedy, "Wilsonia." He is now a fugitive from justice in this State, and the *New York Sun*, *Scribner's Magazine* and other high-class publications are carrying the advertisement of his fraudulent business, which he directs from various Western cities.

The fact that the promoters of "Electropoise" have rested for four weeks without taking legal steps to compel ELECTRICITY to prove its charges is proof positive of their own knowledge that they are engaged in a swindling business.

The following are a few of the many communications on the subject received this week :

To the Editor of ELECTRICITY.

DEAR SIR : You are deserving of the highest commendation for the stand you have taken in regard to electro-medical frauds as well as other matters. And especially do you deserve credit for your fearless presentation of facts, and I wish personally to thank you for your position in relation to the religious papers, etc., who have exploited the "fake" device. I think the religious press, which assumes to represent the beliefs of myself and others in things outside of affairs temporal, should be beyond a possibility of reproach in accepting advertising matter of such a nature, in order to be consistent with the tone of the reading matter of the paper. The purpose seems to have "miscarried." Bring these papers to time and you will have the heartfelt thanks of myself and thousands of other readers of your paper.

Trade journalism will find your stand the ideal to *follow* after you have paved the way.

N. S. AMSTUTZ.

Cleveland, O., November 30.

To the Editor of ELECTRICITY.

DEAR SIR : I have noticed with pleasure your various articles from week to week, and especially your issue of the 28th ult., in which you show up so splendidly in the true light "The National School of Electricity" and "Electropoise." I have noted for some time the advertisements of the National School of Electricity and places which they propose establishing in the North, and wondered what could be given as a course for a fee of $17.50. I called the attention of my class over a year ago to the fraud sailing under the name of Electropoise, explaining its total inability to prove efficacious from any standpoint, whether electrical, magnetic or otherwise, and am delighted to see the stand you take relative to same. Yours very truly,

L. D. BLISS.

The Bliss School of Electricity, Washington, December 1.

To the Editor of ELECTRICITY.

DEAR SIR : I have read with interest in your paper your hearty words concerning the course of the *Sunday School Times*. I will merely add that we rejected the advertisement of the Electropoise on its own merits, or lack of merit, as shown in its sweeping claims. Yours sincerely,

H. CLAY TRUMBULL.

Sunday School Times Editorial Rooms, Philadelphia, December 1.

To the Editor of ELECTRICITY.

DEAR SIR : We heartily sympathize in any movement that will tend to lay fraud bare to the public, especially fraud of the character referred to, which numbers among its victims the sick, the needy and the uneducated. Very truly yours,

HOUSTON & KENNELLY,

Houston & Kennelly, Electrical Experts, Philadelphia, December 4.

To the Editor of ELECTRICITY.

DEAR SIR : On the appearance of your issue of November 28 the writer sent you an explicit denial of your published statement attributed to him concerning the *Sunday School Times*. Will you kindly let your readers know this ? Very truly yours, JOHN W. PRITCHARD.

Christian Nation, New York, December 5.

[Nevertheless, our statement was true in every detail.]

MR. E. B. GREENE, Pub.

SIR : I have been amused by reading your request in the *N. Y. Tribune* of Nov. 25 for communication with persons who have "been misled into purchasing an Electropoise,—'the electro-therapeutic humbug described in 'ELECTRICITY.'" I, Otto Schumm, am one of the numerous thousands who have been *led* into purchasing the Electropoise, and as my understanding grasped its meaning almost upon first trial, I wonder what Mr. Greene bought the little marvel for, or, what is the gentlemen talking about? Or does he talk from hearsay merely ? I have not seen the alleged "description" in ELECTRICITY, but that description is the humbug, I aver, and not the Electropoise. When Mr. Greene wakes up, wiser and with a better conviction, I also wonder what style of dress he will give his apology for his defamation of one of the greatest wonders of all time, and how the difference will be finally settled between him (the defamer) and the Electropoise Company.

But enough. If Mr. E B. Greene desires an interview with the undersigned, I am at home, at 159 Pulaski street, Brooklyn, Sunday Morning next from 7 to 9, or evenings after 9.

I fear no difficulty in enlightening Mr. Greene on the subject and look forward with pleasure to the time when he shall understand more about the subject he hurls his thunder at.

Till then,—

OTTO SCHUMM,
Expert in Electrolibration.

159 Pulaski street, Brooklyn, Dec. 4, '94.

[There is no lunatic asylum at 159 Pulaski street, and Mr. Schumm is mistaken when he says he is at home there; his natural home would be Flatbush or Bloomingdale.]

STORAGE BATTERY CONSOLIDATION.

Official information is now at hand concerning the consolidation of the various competing storage battery interests referred to by us a week ago.

The Electric Storage Battery Company has acquired all the rights and patents of the Consolidated Electric Storage Company, the battery patents and rights of the Brush Electric Company of Cleveland, the battery patents of the General Electric Company, all the property, rights and patents of the General Electric Launch Company and the Electric Launch and Navigation Company, and the rights, licenses and patents of the Accumulator Company.

Philadelphia will be the headquarters of the consolidated company, where the Electric Storage Battery Company has a large new factory.

Mr. Griscom, of the Accumulator Company, will probably retain his connection with the new company, and Mr. Bracken will probably be in charge of the launch business.

The company has filed a certificate in the office of the Secretary of State of New Jersey, increasing its capital stock $3,500,000, making the total capital stock $13,500,000.

Death of Frederick Degenhart.

Mr. Frederick Degenhart, Chicago manager of the Standard Underground Cable Company, died in that city on Friday last of pneumonia.

Mr. Degenhart was known to everyone in the trade, and had hundreds of friends. He was in the prime of life, and his death will cause genuine sorrow to all who knew him and appreciated his sunny disposition and manly habits.

Personal.

Mr. James W. Godfrey, for nearly nine years general manager of the New York Insulated Wire Company, and Mr. Frank Harrington, the leading salesman, have retired from the company. They will still be in the wire business, though the plans are not yet officially announced.

The Old Colony Trust Company of Boston has brought suit at Dubuque, Iowa, on a trust deed for $400,000 against the Dubuque Light and Traction Company. The company has failed to make payments of coupons since December, 1893, and has also defaulted on the payment of taxes. The plaintiff asks the appointment of a receiver to operate the road and a foreclosure of the mortgage.

LEGAL NOTES.

Ralph E. Rust, receiver of the National Electric Manufacturing Company of Wisconsin, brought suit in St. Louis against the Western Electrical Supply Company, on account. Rust was appointed receiver by a court in Wisconsin, and the question was whether a receiver appointed in another State could come into a Missouri court and sue for and collect in a Missouri jurisdiction the assets that belonged to the corporation before his appointment. Judge Valliant decided that he could not; a receiver is an "arm of the court," but the court can reach no further than it has jurisdiction. He rendered judgment, therefore, for the defendant.

At the instance of the American Loan and Trust Company of Boston, Watson Whittlesey has been appointed receiver of the Suburban Traction Company, which operates an electric railway in Orange, N. J., and a horse railway in East Orange and Bloomfield. An injunction also has been granted restraining creditors from selling at sheriff's sale any portion of the company's assets in execution of judgments. The sale set down for the 7th inst. did not therefore come off.

John A. Brill has filed a bill in equity in the United States Circuit Court at Philadelphia against the Delaware County and Philadelphia Electric Railway Company, charging alleged infringements on a number of patented improvements in cars, trucks, motor cars and brakes, the exclusive right to which is claimed by the complainants.

The suit brought by the Thomson Electric Welding Company of Lynn, Mass., against the Two Rivers Manufacturing Company of Wisconsin, has been terminated by the entry of a decree sustaining the validity of the fundamental patents of Elihu Thomson on electric welding and apparatus therefor, and adjudging that the defendants have infringed the same. The Two Rivers Manufacturing Company has settled for the past and taken a license from the Thomson Electric Welding Company.

His Salary Was Larger Than Coffin's.

The United States Court of Appeals at Chicago has handed down a decision setting aside the verdict obtained by Wilbur F. Davidson against the Illinois Central Railroad Company, for personal injuries, amounting to $43,000. The plaintiff was injured at the Hyde Park station on February 27, 1893. He was connected with the General Electric Company, and was in receipt of a salary, according to the evidence produced on the trial, of nearly $60,000 a year.

General News.

What is Going on in the Electrical World.

Toledo, O.—The electric railway from this city to Maumee is completed and was opened for traffic on the 29th ult.

Dunkirk, N. Y.—The Phœnix Telephone Company has been granted a franchise for a telephone service in this city.

Oakland, Cal.—Receiver Ira W. Bishop has been granted permission to change the Piedmont Cable Road into an electric system.

Baltimore, Md.—The Baltimore Traction Company's Gilmore street cable line is to be changed immediately into an electric line.

Parkesburg, Pa.—The stockholders of the Parkesburg Electric Light Company have decided to take steps toward securing a charter.

Staten Island, N. Y.—The New Brighton trustees have granted the petition of the Midland Railway to change its motive power to electricity.

Bayfield, Wis.—This city has purchased the plants of the Water Company and Electric Light Company and will operate them under municipal control.

Corning, N. Y.—Three plans are now on foot to build an electric railway in Corning, and it is expected that a first-class road will be in operation in the near future.

London, Ont.—The local branch of the Canadian General Electric Company will hereafter be known as the London Electric Company, Limited. The capital is $300,000.

Boston, Mass.—The *Herald* states that the Westinghouse Electric Company has contracted to supply the West End Street Railway with 110 motors.

Kansas City, Mo.—The Rosedale avenue motor line is being changed to an electric system. The changing of the system from steam to electricity will require an outlay of about $15,000.

Santa Fe, N. M.—The water, gas and electric light interests of this city will henceforth be under one management, the Santa Fe Water and Improvement Company having secured control.

Milwaukee, Wis.—The indications are that the North Greenfield division of the Milwaukee and Wauwatosa Motor Railroad, which runs to the State fair grounds, will be equipped as an electric road by next summer.

San Antonio, Tex.—The Fort Wayne Electric Company's plant here has been damaged by fire to the extent of $7,500. The fire originated in an explosion at the electrical repair and electroplating establishment of B. Dubinski.

Alexandria, Ind.—A contract has been signed looking to the construction of the Indianapolis, Alexandria, Anderson and Marion Electric Railway, the estimated cost of which is $525,000. F. M. Dice is president of the company.

Oshkosh, Wis.—There seems now to be no doubt that the electric street railway for which J. K. Tillotson was granted a franchise by the council some months ago will be constructed. Work on the road began on the 1st inst.

Watkins, N. Y.—The Watkins and Havana Electric Railroad Company has been formed for the purpose of building a railway line between here and Havana. Incorporation papers have been made out and sent to the Secretary of State.

Pittsburg, Pa.—The Westinghouse Electric and Manufacturing Company on the 5th inst. declared a quarterly dividend of $1\frac{3}{4}$ per cent. upon the preferred stock, payable January 2, 1895. Transfer books close on December 22 and open on January 3.

Niagara Falls, N. Y.—The Pittsburg Reduction Company, manufacturers of aluminum, have completed their new factory at the model village built by the Cataract Construction Company, three miles above Niagara Falls, and are awaiting the installation of electric power.

Paulsboro, N. J.—The project of building a trolley road between this place, Clarksboro, Swedesboro and Woodbury is progressing. The system, as proposed, is the underground conduit. The company which proposes to build the road has, it is said, plenty of money to back it in its undertaking.

Ithaca, N. Y.—Mr. Stephen Vail, son of Alfred Vail, the co worker with Prof. S. F. A. Morse in the invention and development of the electric telegraph, has presented to the electrical museum of Cornell University a piece of the wire over which passed the first message transmitted by the magnetic telegraph.

Chicopee, Mass.—The board of aldermen have granted a franchise to the Holyoke Street Railway Company to build an electric railway from the Willimansett bridge to this city. This will complete the much desired link between Springfield and Holyoke. The line must be built and in operation by November 1, 1895.

Augusta, Me.—Superintendent Meloon of the Augusta, Gardiner and Hallowell Electric road has made a small electric heater that can be adjusted to the electric light wire in a bedroom and furnish sufficient heat to warm a fair sized room in a few minutes. To attach it it is only necessary to remove the light globe and screw the heater on.

Milan, Mo.—The permanent organization of the Milan Telephone Company was perfected at a recent meeting of the stockholders by electing Isaac Guinn president and Dr. W. T. Stephenson secretary and treasurer. The line connects Milan with Browning, Linneus, Laclede, Brookfield, St. Catherine, Becklin, Marceline and Macon City.

Bennington, Vt.—The bills for a charter for the Bennington electric railway and the Bennington and Woodford electric railroad have passed both branches of the Vermont Legislature and received the Governor's signature. Some preliminary steps toward building the Bennington and Woodford line will probably be undertaken this winter.

New Orleans, La.—There are now six electric railway lines in operation in this city, five of which have been electrically equipped during the year. The Magazine street line and the Coliseum line, both electric, will soon be completed, and the Orleans road is to be changed shortly to an electric. When this is done there will be only one or two mule lines left.

Cherokee, Kan.—A new town, with electric lights, waterworks and a four-block zinc smelter is to be built eight miles west of here as soon as the work can be done. A coal shaft is to be sunk immediately and 100 tenements erected. The Southwest Coal and Improvement Company, which owns several thousand acres of coal lands in Cherokee County, is back of the enterprise.

Wheeling, W. Va.—The *Intelligencer* says: "J. B Hall, the inventor of the Hall process of manufacturing aluminum, controlled by the American Electric Smelting Company, is in Pittsburg, where he is making arrangements for a specially built electric dynamo to be brought to Wheeling next week for the purpose of giving a practical demonstration of the Hall method."

Monticello, N. Y.—There is a project on foot to build an electric railroad through the Neversink Valley, in Sullivan County, to Grahamsville and from Fallsburg to Monticello. The right of way is being looked after and a site has been secured along the Neversink River to erect a dam for water power. This project is probably some relation to the scheme of a year ago to dam the Neversink and furnish light and power to a large section of Orange County.

Wallaceburg, Mich.—The Hamilton and Lake Erie Power Company through its solicitors will make application at the next session of the Ontario Legislature to acquire the right to construct, operate or dispose of a watercourse and raceway from some point on Lake Erie east of Dunnville to some point on Lake Ontario or Burlington Bay, and to build works in connection therewith for the purpose of generating electrical energy for manufacturing purposes. The fall from Lake Erie to the head of Lake Ontario is said to be 300 feet, and the power will be immense.

St. Louis.—Dr. Wellington Adams, president of the Chicago and St. Louis Electric Road, said a few days ago that the road "will most certainly be built, but not until after a revival of business. Already," he continued, "$8,000,000 of the $10,000,000 worth of bonds have been placed, and it will not be much trouble to place the remainder. The grading and securing of right of way is going steadily on."—President Green of the Fourth Street cable line has determined to give the underground system a trial on a portion of that line, and if this proves successful will equip the entire line in the same way.

Detroit, Mich.—The *Free Press* states that a number of Detroit capitalists have formed a syndicate for the purpose of building an electric railway from the dividing line between Wayne and Oakland counties, through Birmingham to Pontiac, to give these places better connection with this city. E. W. Voigt, the brewer, is at the head of the syndicate.—The new ordinance giving the Detroit Railway Company (of which the Pack brothers and H. A. Everett are the leading figures) the right to run street cars in the streets of Detroit has been signed by Mayor Pingree and becomes a municipal law. Three cent fares are to be a feature of the new system.

Washington, D. C.—The Elkins-Widener-Newbold syndicate is about to begin the constructon of the Washington and Baltimore Boulevard trolley road, 32 miles long. Contracts for 17 miles will be let in a few days. The first section between Washington and Laurel is expected to be in operation by April 1, 1895. It is estimated the road will cost $1,000,000. It will be double-tracked and laid with 80 pound steel rails. The trains will have a guaranteed speed of sixty miles per hour, the fastest schedule time for any electric or other railway. The block signal system will be used. It is proposed to have the entire line in operation by midsummer.

Atchison, Kan.—The opening of the electric street railroad here was deemed of such local importance as to warrant a general celebration on the 11th inst. The programme announced that "two bands will play on the streets during the day and evening, speaking at the theatre in the afternoon by Governor-elect Morrill, a football game, a ball at McInteer's Hall, a play at the theatre in the evening by Frohman's Comedy

Company, and last, but not least, a grand parade and display by the Flambeau Club. Two hundred dollars have been handed to the captain of this club to defray the expense. A banquet will be given at the Byram in honor of Governor-elect Morrill and Hon. B. P. Waggener."

Philadelphia.—The People's and Electric Traction companies have agreed on an arrangement for transfer of passengers for one fare at nearly every intersecting point on the respective lines. "This agreement," says the *Ledger*, "will make a powerful combination. The relations of the two companies will naturally be very close and many of their interests will be identical. It will be a combination that will probably be a formidable competitor of the Philadelphia Traction Company, and will practically place the passenger railways of this city in two great systems—that of the Philadelphia Traction Company and of the People's Electric Traction Combination."

New York.—At a meeting of the directors of the New York and Philadelphia electric railroad last week, it was decided to begin work on that portion of the road lying between Raritan and New Brunswick as soon as the materials can be secured.—The new telegraph line of the Postal Telegraph Company from this city to San Francisco has been completed. The circuit is 3,750 miles in length. The wire and construction are of the best class and cost $500,000. Eight months were required to build the line. Heretofore the Postal Telegraph Company's only connection with the Pacific Coast was by the way of the Canadian Pacific lines. Now it has two routes, the one formerly used and that just completed and they are so far apart that the same storm is not likely to interfere with the working of the two lines at the same time.

Fall River, Mass.—Rufus A. Soule, Wm. M. Butler and A. P. Smith, of New Bedford, Henry B. Leonard, of Somerset, and Benjamin Cook, of Fall River, as directors of a street railway company proposing to lay out thirty-five miles of railroad between Fall River and Providence and Fall River and Taunton, have petitioned the authorities at Fall River and Somerset for electric road franchises in the streets of those cities.—A company has been recently organized to build and operate a street railway in this city. The motive power will be electricity. The articles of agreement have been signed by Wendell E. Turner, Arnold B. Sanford, Albert S. Dow, Herbert Field, M. T. Hudner, James E. Osborn and Frank Shove. These with other citizens have subscribed $50,000 and the road will be built as soon as a franchise is obtained.

The Stanley Company's New Office Building.

The new office building of the Stanley Electric Manufacturing Company at Pittsfield, Mass., is now ready for occupancy. The building is conveniently arranged and is equipped with all the necessary appliances for the comfort of the company's large clerical force. The building is connected with the big shop on the north by an underground passageway, and another connection is to be made by a bridge at the second story.

The business of the Stanley Company continues to increase, and the new shop, which it was supposed would be adequate for the present, is already crowded with work and is being run twenty-three hours out of the twenty-four. If the business continues to increase and the future continues to be as full of promise as the present, another big shop will be erected in the near future between the present buildings and Pearl street.

Whitney Instruments in the South.

Mr. H. S. Sands, of Wheeling, W. Va., has accepted the agency of the Whitney Electrical Instrument Company for the State of West Virginia and the western part of Pennsylvania, and will hereafter carry a line sufficient to meet the wants of the trade in that territory. He is an energetic young contractor and engineer, and will undoubtedly make a success of the agency.

INCORPORATIONS.

The Mahoning Valley Electric Railway Company, Niles, Ohio.—to construct and operate street railways (electric or other motive power, except steam or animal) in Niles, Girard and Youngstown and on highways connecting said places. Capital stock, $150,000. Promoters: C. F. Clapp, R. G. Sykes, Arthur A. Anderson, G. E. Herrick, Andrew Squire, John E. McVey.

The Winamac Electric Light and Power Company, Winamac, Ind.—to manufacture and supply electric light and power. Capital stock, $10,000. Promoters: John H. Weaver, Moses A. Dilts, Isaac V. Smith.

The Ravenna Electric Street Railway and Power Company, Ravenna, Ohio—to build, operate and maintain electric railways within the limits of Portage County, Ohio, and elsewhere; furnish electric power, light and heat, etc. Capital stock, $50,000. Promoters: George H. Worthington, Wm. J. Akers, Geo. W. Gardner, J. H. Evans, R. B. Carnahan.

The Upper Cicero Water and Light Company, Austin, Ill.—to furnish electric light, heat and power; lay water and gas pipes, etc. Capital stock, $50,000. Promoters: Lawrence Crook, Jos. Foschinbaur, Revere Lincoln, Daniel Schustick.

The Cardington Electric Light and Power Company, Cardington, Ohio. Capital stock, $15,000. Incorporators: M. J. Carmack, Evan T. Bowen, T. J. Carmack, E. H. Fishback and H. F. Fishback.

The American Gas Engine Electric Company, Chicago, Ill.—to operate patents for producing power by gas engines, electric motors, etc.; generate electric light, heat and power; manufacture electric cooking, heating and refrigerating apparatus. Capital stock, $250,000. Promoters: Erik Akerberg, J. Ensign Fuller, Albert F. Dexter.

The Rogers Park Lighting Company, Chicago, Ill.—to manufacture, buy and sell electric light, gas, heat and power, and to construct and lay all necessary wires, pipes, poles, conduits and appliances for the distribution thereof. Capital stock, $30,000. Promoters: Henry Heistand, George N. Stone, Lloyd G. Kirkland.

Articles of incorporation were filed at Trenton, N. J., on the 7th inst., by the Trenton Traction Company. The capital stock, $500,000, is divided into 10,000 shares. Of this Thomas C. Barr, of East Orange, N. J., holds 4,000 shares; Edward J. Moore, of Philadelphia, 4,000; George B. Jenkinson, of Newark, 200 shares; Frederick W. Roebling, Trenton, 400; Gen. W. S. Stryker, Trenton, 200; John L. Kuser, Trenton, 800; Hugh H. Hamill, Trenton 200; Francis M. Eppley, West Orange, 200. The Trenton Traction Company is organized to control the Trenton electric lines and to connect by loop with the electric road now being constructed between New York and Philadelphia.

The Suburban Light and Water Company, Wheeling, W. Va.—to establish and maintain water works, electric light, heat and power plant for domestic and other purposes. Capital stock, $500,000. Promoters: August Ralf, Anton Reymann, Paul O. Reymann, Wheeling.

White Hall Electric Company, White Hall. Capital stock, $10,000. Incorporators: Gilbert S. Vasseller, Orlando F. Griswold, Henry W. Hand.

The Greensburg, Jeanette and Pittsburg Street Railway Company, Carlisle, Pa.—to construct, maintain and operate an electric street railway. Capital stock, $150,000. Promoters: W. F. Sadler, A.A. Thomson, W.F. Sadler, Jr., of Carlisle.

The De Land Electric Railroad and Power Company, De Land, Fla.—to construct, maintain and operate a railroad with electricity as a motive power, "trolley system," and furnish electricity for lighting, manufacturing, etc. Capital stock, $300,000. Promoters: John B. Stetson, Theodore Search, Philadelphia; John F. Forbes, of De Land.

The Plainville Electric Light and Power Company, Plainville, Conn. Capital stock, $10,000. Incorporators: C. H. Landers, W. H. Brayton, M. B. Hitchcock, K. F. Tomlinson, Charles S. Landers, F. G. Platt, A. M. Young and D. S. Plume.

The Citizens' Mutual Telephone Company—to construct lines of telephone between Lockport and Niagara Falls. Capital stock, $15,000. Directors: Jos. A. Ward, Wm. V. Trevor, Hiram K. Wickes, Theo. H. Van Horne and others, of Lockport.

The Corning and Painted Post Street Railway Company—to construct a street surface road, about five miles in length, to be operated by electricity. Capital stock, $100,000. Directors: Edward W. Shedd, William H. Tyles, of Worcester, Mass.; H. A. Clark, Caleb L. B. Tylee, Frank H. Viele, John L. Miller, Edwin J. Carpenter and Morris L. Gregory, of Corning, and John W. Clark, of Waverly.

The Thomson-Houston Electric Company of New York has been reorganized under the name of the Madison Square Light Company. The capital is $1,000, and the directors are George W. Maslin and Arthur G. Freeland, of New York City; Richard D. Lankford and Patrick A. Nolan, of Brooklyn; Edmund A. Merrill, of Roselle, N. J., and Isaac N. Lewis, of Fort Wadsworth.

The Nutting Electric Company, at Chicago. Capital stock, $50,000. Incorporators: James W. Hedenberg, Carl K. MacFadden and Frank A. Smith.

The Secretary of State at Jefferson, Mo., has issued a certificate of incorporation to the Sedalia and Brown Springs Electric Railway Company. Capital stock, $80,000. Incorporators: D. C. Metzker, W. E. Sterne, M. E. Sterne, Charles Carroll and D. F. Webster.

An application will be made to the Governor of Pennsylvania, December 19, "for the charter of four intended corporations to be known as the Ohio Valley Electric Company of Emsworth, the Ohio Valley Electric Company of Avalon, the Ohio Valley Electric Company of Bellevue and the Ohio Valley Electric Company of Ben Avon. The object of the corporations is stated to be 'supplying light, heat and power, or all or any of them, to the public by means of electricity.' The incorporators named in each case are: William Jackson, John H. Fults, A. F. McDonald, John C. Spencer and Donald M. Sloane. One company will control the entire enterprise, the separate corporations being chartered in compliance with the State law governing such corporations. The capital stock of the company will be $25,000. The main plant will be located at either Ben Avon or Bellevue and the most distant point to be reached will be two miles from the central plant."

Woven Wire Brushes.

The Belknap Motor Company of Portland, Me., are the patentees and manufacturers of the best Woven Wire Brush on the market.—[*Adv.*

ELECTRICAL PATENT RECORD.

Letters Patent Issued December 4, 1894.

ELECTRIC RAILROADS AND APPLIANCES.

530,192. Electric-Railway System. David Mason, New York, N. Y. Filed Feb. 16, 1894.

530,223. Fender for Trolley-Cars. Charles F. Haug, Brooklyn, N. Y. Filed April 5, 1894.

530,276 Trolley-Catcher. William F. Kendt, Buffalo, N.Y., assignor of two-thirds to George M. Mitchell and Rod. McLeod, same place. Filed May 26, 1894.

530,283. Conduit for Electric Railways. Michael I. Martin, Chicago, Ill. Filed Feb. 7, 1894.

530,286. Electric Tramway. Heinrich Schwieger, Berlin, Germany, assignor to Siemens & Halske, same place. Filed Dec. 22, 1891.

530,482. Electric-Railway Supply System. John J. Green, Boonton, N. J., assignor to the Universal Electric Company of the City of New York. Filed Aug. 21, 1893.

ELECTRIC LIGHTS AND APPLIANCES.

530,313. Electric-Light Fixture. Herman Horn, Philadelphia, Pa., assignor to the Horn & Brannen Manufacturing Company of Pennsylvania. Filed May 24, 1894.

DYNAMOS, MOTORS, ETC.

530,088. Brush for Dynamo-Electric Machines. Pierre J. C. Carron, Pont-de-Claix Isere, France. Filed Feb. 10, 1894.

530,114. Method of and Means for Operating and Controlling Electromotors. Carl Moderegger, Vienna, Austria-Hungary, assignor to Siemens & Halske, Berlin, Germany. Filed Dec. 16, 1893.

530,176. Alternating-Current Motor and Method of Operating Same. Ludwig Gutmann, Pittsburg, Pa. Filed Oct. 30, 1889.

530,177. Alternating Electric Motor. Ludwig Gutmann, Pittsburg, Pa. Filed Dec. 23, 1891.

530,178. Electric Conversion System. Ludwig Gutmann, Pittsburg, Pa. Filed Dec. 23, 1891.

530,235. Magneto-Electric Machine. Joseph N. McLeod, Brooklyn, N. Y. Filed April 2, 1894.

530,465. Dynamo-Regulator. John Van Vleck, New York, N. Y. Filed Oct. 8, 1894.

TELEPHONE AND TELEGRAPH APPARATUS.

530,082. Telegraph-Key. Louis D. Bliss, Washington, D.C., assignor to Charles W. Needham, same place. Filed March 7, 1894.

530,115. Telephone-Transmitter. Miles A. Morehouse, Wevertown, N. Y. Filed March 28, 1894.

530,208. Telephone-Switch. Alfred Stromberg and Androv Carlson, Chicago, Ill. Filed Oct. 9, 1894.

530,315. Telephone-Transmitter. John T. Williams, Brooklyn, N. Y. Filed Aug. 8, 1894.

530,324. Telephone-Exchange System. Romaine Callender, Brantford, Canada. Original application filed Aug. 13, 1892. Divided and this application filed Dec. 18, 1893.

530,325. Telephone-Switch. Romaine Callender, Brantford, Canada. Filed Sept. 15, 1894.

530,412. Telephone-Transmitter. John Goodman and Henry M. Goodman, Louisville, Ky. Filed July 3, 1894.

BATTERIES.

530,260. Primary Battery. Charles W. De Mott New York, N. Y. Filed Dec. 7, 1893.

530,401. Battery Connection. Walter S. Doe, Brooklyn, N. Y., assignor of one-half to Henry Thompson, same place. Filed Aug. 27, 1894.

530,432. System of Electrical Distribution with Storage-Batteries. Emil Kuchenmeister, Berlin, Germany, assignor to Siemens & Halske, same place. Filed Nov. 25, 1892.

530,485 Primary Battery. Charles J. Hubbell, New York, N. Y., assignor to J. J. Darlington, trustee, Washington, D. C. Filed April 30, 1894.

SIGNALS AND SIGNALING APPARATUS.

530,093. Electric Railway Signaling. William Daves, Jersey City, N. J., assignor to the Hall Signal Company, of Maine. Filed May 24, 1894.

530,236. Signaling Apparatus. Bernice J. Noyes, Boston, Mass., assignor to George W. Gregory, same place. Filed Feb. 18, 1890.

MISCELLANEOUS.

530,141. Service End, Cut-Out, and Switch-Box for Electric Lighting Circuits. John Van Vleck, New York, N. Y. Filed May 28, 1894.

530,145. Electrometer. Edward Weston, Newark, N. J. Filed April 26, 1893.

530,184. Circuit-Closer. Herbert V. Keeson, London, England. Filed Sept. 17, 1894.

530,253. Electric Bell. Edward G. Worley, New York, N.Y. Filed June 13, 1894.

530,293. Electric Switch. Ike W. Ullman, Birmingham, Ala. Filed Sept. 28, 1894.

530,344. Electric Dental Engine. Joseph A. Jeffrey and Benjamin A. Jeffrey, San Francisco, Cal. Filed April 5, 1894.

530,351. Electric Meter. Gustave A. Scheeffer, Peoria, Ill., assignor to the Diamond Electric Company, same place. Filed July 17, 1894.

530,399. Insulator for Electric Conductors. John H. Croskey and Joseph Locke, Pittsburg, Pa. Filed Sept. 28, 1894.

530,411. Burglar-Alarm for Safes. James W. Gilstrap, Rolla; and William D. Gilstrap, Racine, assignors of one third to Austin L. McRae, Rolla, Mo. Filed April 24, 1894

530,430. Thermal Circuit-Breaker. Henry Klein, Janesville, Wis. Filed May 19, 1894.

530,472. Electric Switch. John M. Cronin, Cambridge, assignor to Jas. L. Wesson, Boston, Mass. Filed Sept. 22, 1894.

ELECTRICITY.

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THE AMERICAN NEWS COMPANY,
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N. E. L. A.—The next annual meeting of the National Electric Light Association will be held at Cleveland, O., February 19-21, 1895. Every concern interested in either lighting or railway work should be represented in the membership of this body, and should have at least one representative at the Cleveland meeting. The Secretary is Mr. Geo. F. Porter, 136 Liberty street, New York.

Mr. Dunn's Paper in Pamphlet Form.

The high educational value of Mr. Dunn's Paper on "Direct Current Motor and Dynamo Design," now running in Electricity, and the general demand for it in convenient form for preservation and reference, has induced the publishers to announce that immediately upon its completion in these columns it will be issued in pamphlet form. Those desiring copies may procure them by addressing the undersigned. Price 10 cents per copy, postage paid.

Electricity Newspaper Company,
6 Park Place, New York.

The Welsbach Light Pamphlet.

The matter published in our issues of November 28 and December 12, on the "Welsbach Light," universally admitted to be the most complete treatise on the subject thus far published, has been collected in pamphlet form and is now ready for delivery. Every central station man should procure copies for distribution. Price $15 per 1,000 in any quantity. Orders for over 75,000 copies were received in advance of publication.

Note.—Table of Contents for this week will be found on page 276.

EDITORIAL NOTES.

Accumulators for Tramcar Traction By special arrangement we are enabled to print in advance of our contemporaries the first part of a Paper by Mr. Alfred H. Gibbings read before the Northern Society of Electrical Engineers (Manchester, England,) on "The Commercial Possibilities of Accumulators for Tramcar Traction, Considered as a Municipal Undertaking." We think this Paper will attract a great deal of attention as in it are emphasized the benefits derivable from the union of endeavors not inconsistent in themselves nor necessarily along the same lines, which, as the author says, "separately may be only just paying their way, but combined it will probably become possible to make an exceptional success of both."

The author uses this as an argument in favor of municipal control of electric traction, but it has a wider and broader significance. We do not approve of municipal control in this country of either the railways or lighting stations, but this does not militate against our acceptance of the general principle enunciated, that a consolidation of interests in private hands may redound to the mutual benefit of all concerned.

There is no more serious question before the electrical interests than that of how to equalize the load on the expensive plants which all electrical supply stations are compelled to supply themselves with. It is probably safe to say that in the ordinary condition of working in the most carefully handled central stations the amount of extra fuel used owing to the intermittent character of the demand upon the boilers is over 40 per cent. in excess of what would be required if this cause of loss were abolished, and this may amount to a loss of $50,000 a year in a station of no extravagant dimensions. Figures are not wanting, nor experience either, to show that a system of storage of some kind is imperatively demanded. We may combine two or more interests, as suggested by Mr. Gibbings, and reduce the irregularity of the demands to a considerable extent, but no combination of interests thus far suggested will even approximately make our load line straight. We must have for our energy what the gas manufacturer has for his gas—some means of storing it up during the hours of light demand against those of heavy demand. But the question arises, what shall we store? We have three well-known methods at hand: by pumping water up into a reservoir, as suggested by Forbes, storing it chemically as in the storage battery, and as heat in thermal storage. The first of these methods is probably the most efficient of the three as it permits of indefinite storage, but it is not always available—in fact in few cases is available. Chemical storage, as we all know, is subject to some inherent weaknesses and inefficiencies which canno be overcome even in a theoretically perfect storage battery. It is subject to some others, which are due to the frailties of all human designs, but it is applicable wherever electricity is the product desired. It is this method of storage that the author advocates, and he makes out for it a very good case indeed.

The third method is that of thermal storage, which the author mentions, but dismisses so lightly as to lead to the conclusion that he has not looked into it at all. In fact the following statement would indicate that he was entirely ignorant of the latest development in that line. He says:

"In considering the whole matter I had brought before my notice what had already been done with regard to thermal storage. There may be possibilities in thermal storage which are not yet matters of common knowledge. This, of course, may be especially the case where sudden demands for abnormal power for short periods would be made, as in that case the steady and continuous power generated might be stored. But the only reliable working statistics we have are those connected with a steam tramway in India, where the engines obtain sufficient power for one journey from a reservoir of high pressure steam."

He is correct, however, in his statement that there are no working data in regard to this method, which has become known as Halpin's method of thermal storage, for no plants have as yet been put into operation on this system, but it is susceptible of theoretical demonstration that it will have an efficiency second only to that of water storage and at an initial outlay usually considerably smaller. It has the advantage over water storage of being universally applicable. It will be remembered that Prof. Forbes read a paper before the National Electric Light Association at St. Louis on Halpin's method as then developed in which he gave it his unqualified endorsement. It has since been developed to a considerably greater degree, and a plant is now in process of construction in which it will be employed in its improved form. There are three methods of thermal storage now quite prominently before the public, known as the "Feed Storage," "Steam Storage" and "Combined Feed and Steam Storage" systems. The relative cost of introducing these various systems, as given by careful calculations, are, if we assume the cost of an ordinary steam installation to be represented by 30: for feed storage, 29; for steam storage, 59.5, and for combined feed and steam storage, 47.4.

Comparing the cost for installation of a thermal storage plant with that of an equivalent storage battery, Prof. Unwin says that for thermal storage it would cost £1.64 per brake horse-power with condensing engines, or £2.24 with non condensing engines, while for battery storage a plant would cost £8 per brake horse-power. Prof. Geo. Forbes states that water storage under favorable conditions would be quite as cheap as thermal storage, though, as shown, water storage is in many cases impracticable.

We have digressed merely to show that we are justified in considering that the author has discarded the method of thermal storage in too trivial a manner, but this does not detract in any degree from the force of his argument that storage of some kind is essential to economy and that by co operation of different interests this may be effected with increased economy to all the interests involved.

What he says of the fuel value of town refuse will come as a surprise to most people on this side of the water, simply for the reason that we have not looked into it here; but abroad, especially in England, much attention has been given to the subject and it is familiar to all. But while his facts are essentially correct, Mr. Gibbings has allowed himself to fall into a very careless error in figures which will affect his results quantitatively. Thus he says:

"This 45 I. H. P. would give *at least* 40.5 E. H. P. at an efficiency of electrical machinery of only 90 per cent. or a continuous output of 400 amperes at 75 volts, for . . . the electrical machinery would be designed to always work at full load."

Of course 45 *indicated* H. P. cannot give 40.5 E. H. P. His engines would be working *exceedingly* well if at 45 I. H. P. they would produce 40.5 *brake* H. P., and then there would be the further loss by belt, or gearing, or friction, etc., and 10 per cent. more in the dynamo, before he would have his electrical horse-power, which he would find would pay out nearer 35 H. P. than 40.5, and probably nearer 30 than either.

In summing up the disadvantanges of systems not using accumulators he catalogues them as ollows:

"1. Irregular demands upon the generating plant."

This is an unquestioned disadvantage, easily amounting to 40 per cent. or more in operating expenses.

"2. Greater wear and tear of the machinery."

This is only in a measure true, for in introducing storage batteries we transfer the extra wear and tear from the other machinery to the storage battery plant.

"3. Capacity of generating plant must be equal to all possible demand upon it."

This is also true, but supposing that by means of storage we are enabled to reduce the size of our generating plant by half, our storage plant must be at least equal to this, so that the *capacity* of our plant as a *whole* will not be diminished but in most cases increased. If the storage batteries are to be used on cars, the storage battery plant must have a capacity at least double that of the generating plant, so that the total capacity of the plant will be at least 1½ times that of the plant without storage. But notwithstanding this increased outlay it is probable that the greatly increased efficiency of the smaller generating plant working constantly at full load will more than counterbalance the increased cost of the plant with storage. We think a more economical method of procedure than the one suggested would be to feed a trolley wire from a set of storage batteries permanently located in the power station, or from several such sets located in relief stations. But where the trolley is objected to this would be impracticable.

"4. Plant standing idle when cars are not running.

"5. Stringent requirements of the Board of Trade as to insulation and periodical tests.

"6. Greater original outlay of capital."

We have endeavored to show that this objection does not hold. All experience goes to show that the original outlay for a storage plant would be greater and that the economy must be sought in decreased operating expenses.

"7. Impossible to economically use the power which the electric lighting station might contribute during the day."

This is the great crying evil of present methods and anything that would tend to remedy it, even if it be costly at first, is worthy of our closest attention.

"8. Inability of the refuse destructor station to supply *the whole* of the power required, hence,

"9. Necessity to erect independent central generating station to supply additional power required.

"10. For reasons contained in 8 and 9 very little, if any, advantage in point of economical working would arise from the aid of the refuse destructor."

It may be well to point out that although we have not come to the cremation of town refuse in this country yet, and may not for some years, or ever, we still have the important question confronting us as to how to utilize to advantage those vast quantities of cheaper fuels, too poor to use by present methods, but which contain in diluted form the energy of millions of tons of the best of coal. We are convinced that the solution of this problem is to be found in some method of storage. In one case the electric storage will be best. In another water storage, and in a third thermal storage. Each case must be decided by itself, but that storage of energy in some form or other is an imperative demand of the times must go without question.

* * *

Storage Battery Matters. The consolidation of all material storage battery interests in this country, previously mentioned in ELECTRICITY, is now completed. The news has been received with satisfaction by the trade generally. We have so often commented on the disagreeable features of the storage battery situation here previous to the consolidation that our views are well known.

There is no reason why America should not be equal to all the other countries of the world as a market for a practical accumulator. The field is here, and we are convinced that, on general principles, a consolidation of heretofore conflicting interests was desirable.

The gentlemen now in control of the situation are men of sagacity and large capital. There is little reason to doubt that they will use their past opportunities to the benefit of the public, and thereby of themselves. They know that no permanent success can come without public approval, and we are confident that their policy will be broad enough and liberal enough to encourage an increasing adoption of accumulator service by central stations generally.

That America has fallen behind in this line is not the fault of the public or of the American inventor, but of a mistaken policy which needs no further criticism.

Purchasers may now invest with a feeling of security against litigation, and with the knowledge that the best in the world is at their disposal.

* * *

The Welsbach Light. The general call from various sections of the country for copies of ELECTRICITY's pamphlet treating of the merits and demerits of the Welsbach light, shows that there is a widespread interest in the subject. We are convinced that it is but a short-lived competitor, but that it *is* a competitor is beyond question. Further investigations made furnish added proof that our analysis of its weaknesses was correct. The Welsbach burners were tried and discarded in the large dry-goods house of Bloomingdale Bros., because of the extremely short life of the hoods, and the fact that the quality of light began to deteriorate after a few hours' burning, rendering new hoods necessary long before they were broken. Attempts to clean them resulted in a breakage of 40 per cent. of the hoods.

They were tried in the show rooms of Dorflinger Bros., the leading American cut-glass makers, and would have ruined the business of the company if they had been long continued. The purest and whitest of the product was made to look as green as the cheapest grade of window glass, and the electric light was soon reinstalled.

The public may as well be prevented from wandering off after false gods, even for one season, and it is believed that our pamphlet is a convincing argument that the Welsbach light is a false god.

Under the Searchlight.

Views and Opinions on Timely Topics.

IT APPEARS that the recent notice of a contract given by the West End Company of Boston to the G. E. Company was given out by the latter company and was not correct. The total purchase was 110 motors and the Westinghouse Company got half the order.

* * *

IT IS said that the Chicago offices of the G. E. Company are to be closed, and that one salesman only will be left there. When it is remembered that two years ago the force in Chicago numbered 300, the collapse of this organization is made clear.

* * *

MR. GEORGE ROWE, who died in this city a few days ago, was the best known electrical man in the far West. He had been a power in California for years, and had made a large fortune. He was one of the few men who understood Mr. C. A. Coffin thoroughly years ago, and who never allowed himself or his friends to be humbugged by the schemes of the Boston financier.

* * *

IT IS good opinion that the firm of Webster & Beach is soon to be dissolved, and that Mr. Beach will return to his old position in the supply department of the General Electric Company.

* * *

THE Street Railway and Illuminating Properties have retired 4,424 additional shares preferred stock, costing an average of $109.54. The common stock is now quoted at 27. At the present ratio the syndicate will make a profit of over $2,000,000, which, of course, according to law and morals, all belonged to the stockholders of the G. E. Company.

* * *

THE U. S. Supreme Court adjourns on Friday next until January 7. There can, therefore, be no decision on the Bate case or the McKeesport case, in which all makers and users of incandescent lamps are interested, until that date—the first Monday of the new year.

* * *

Mr. F. P. Fish and His Denial.

THE *Electrical Engineer*, whose only reason for being was to stand up and be licked by the *Electrical World*, printed last week a denial of our recent report of statements made by Mr. F. P. Fish in regard to the appointment of Attorney-General Olney and the probable decision in the Bate Refrigerator case.

We see no reason to corret our statement. Our report came from an honorable gentleman, who stands ready to verify it if called upon. Mr. Fish is a lawyer, and knows how to get at our proof.

At the same time he might like some information in regard to his connection with the blueprint steal at Pittsburg, and also in regard to an agreement between himself and opposing counsel whereby important testimony relative to the previous conduct of both parties was to be squelched. We can give this all to Mr. Fish in one dose if he desires it.

As for the *Electrical Engineer*, we have no feelings except those of pity for it, dying a lingering death, and furnishing a horrible example of journalistic paresis.

* * *

Not Alone in Germany.

(From the Western Electrician.)

ELECTRICITY is gradually gaining a foothold in mining operations in Germany.

ELECTRICITY *has gained* a strong foothold throughout the civilized world. True merit is always appreciated.

Cathode Rays.

M. Poincaré describes, in the current number of the *Revue Generale des Sciences*, some interesting investigations recently carried out by M. Lenard on the properties of the cathode rays in vacuum tubes. Crookes, in his beautiful experiments with the electrical discharge in vacuum tubes, found that when the pressure was very small, the negative electrode was surrounded by a space almost completely dark. In this space, however, rays were found to exist capable of impressing photographic media, of rendering phosphorescent bodies luminous, and of producing various calorific and mechanical effects; these were the cathode rays.

The properties of these rays have been investigated by Hittorf, Goldstein, Hertz, Ebert and Wiedemann, etc., and various theories have been proposed to explain them. Puluj, for example, imagined that they consisted of particles mechanically detached from the electrode; but this theory was experimentally shown by Crookes to be false. The theory proposed by Crookes himself was the well known hypothesis of radiant matter, according to which the rays consisted of molecules of the gas whose free path had been enormously extended by the rarefaction of the gas.

These recent experiments of M. Lenard, in the opinion of Poincaré, not only give the death blow to Crookes's hypothesis, but also throw considerable doubt on the validity of the kinetic theory of gases. The fundamental idea in M. Lenard's experiments was to ascertain whether the cathode rays would propagate themselves in media different from those in which they were generated. It is well known that these rays can only be generated in highly rarefied media, and under conditions completely determined by Crookes. But once produced, the question was whether they could be propagated in a gas at ordinary pressure or in an absolute vacuum. As these rays are intercepted by glass, it appeared almost impossible that means could be devised of allowing them to pass from a gas at one pressure into one at a different pressure. This difficulty was, however, overcome by the ingenuity of M. Lenard. Taking advantage of an experiment of Hertz, in which he had shown that very thin metallic plates are transparent to the cathode rays, Lenard set about discovering a metal foil sufficiently impermeable and resistant to the air, and yet transparent to the cathode rays. A plate of aluminium, from ·002 to ·003 mm. in thickness, was found to fulfil the required conditions.

If a Geissler tube is taken, having one extremity hermetically sealed by a metal plate, with a diametral slit of 1 to 2 mm. in width, which is covered by the aluminium foil, it can soon be ascertained that the rays traverse the thin foil, and leave the Geissler tube. This result is of the first importance; the cathode rays can propagate themselves in air at the ordinary pressure, and also, it can be shown, in the same way that they can propagate themselves in an absolute vacuum. Here the hypothesis of radiant matter is entirely at fault; the experiment necessarily leads to the conclusion that the phenomenon takes place in the ether.

Many interesting questions are raised by these curious results. Why do the rays pass through the aluminium foil while they are stopped by the glass? Is it because of the difference between conductors and dielectrics? It can easily be ascertained that the thinness of the plate is the only essential condition; conductors and dielectrics behave exactly alike, provided they are of sufficient thinness.

The rays are not very distinctly visible in air or gas, especially if they are rarefied, and it is difficult to follow their path with certainty by the eye, but fortunately they can be made more visible by their action on phosphorescent substances, or their course can be determined by their photographic effect. In the apparatus of Lenard the vacuum tube was surrounded by a metallic case to screen off electric forces, and on the end opposite the aluminium covered slit a dark slide was fitted to obtain a record of the bundle of emitted rays.

The rays do not propagate themselves in a straight line; they turn round opaque bodies. This is a very important fact.

Gases, even when rarefied, are, for the rays, disturbing media. To study the propagation of the rays, M. Lenard examined the shadow thrown by a small screen of mica on a phosphorescent screen. It was soon ascertained that as the bundle of rays progressed in the disturbed medium more and more rays were deflected from the straight line. The deflected rays were partly absorbed by the gas, and the more disturbed the medium was the more absorbent it became. It was possible with the apparatus to measure the degree of permeability of different gases at different pressures. Air, for example, at 760 mm. pressure, in one experiment was penetrated to a maximum distance of 2·85 cm., at 0·019 mm. it was penetrated to a thickness of 140 cm.; hydrogen, at 760 mm., was penetrated to 10·6 cm. only, but at 0·164 mm. to 130 cm. These results show how considerable the absorption may become, and how the absorption in all gases tends to become equal at low pressures. It is possible also, by examining the luminous projection of the circular opening of a screen, to measure the degree of disturbance of the different gaseous media. The result is remarkable; if the different media are arranged in decreasing order of disturbance, they will be found to be arranged in the order of their densities. The unique property of a gaseous medium which determines the degree of its disturbance is its density. The nature of the gas is of no importance; equal masses produce equal disturbances.

Hertz was the first to observe that there exist cathode rays of different kinds which correspond to luminous rays of different colors, and which differ in their capacity for phosphorescence and absorption. The experiments of M. Lenard fully confirm this observation. The cathode rays change when the pressure of the tube producing them changes; their properties are no longer identical. For instance, the rays produced at less rarefactions are less diffused than those produced at greater rarefactions when they are afterwards propagated in the same medium.

Lastly, the very curious action of the magnet on the cathode rays is alluded to. A magnetic field, even though very weak, strongly deflects the rays. The deviation is variable with the strength of the field, but the conditions being equal, with the same field the deviation of a beam is the same in all gases and under all pressures. This important fact shows that the deviation can only be due to the magnetic deformation of the ether. It is also very remarkable that the deviation is different for different rays (produced at different degrees of rarefaction); if we suppose they are, so to speak, different colors the magnet acts as the prism which separates and disperses the colors.

M. Hess has proposed to utilize the deflection of the cathode rays in the magnetic field to register photographically rapidly varying currents. But Poincaré considers these experiments have a still greater importance from a theoretical than from a practical point of view. He considers that Crookes's theory of radiant matter fails to explain these new phenomena, and is no longer tenable. Moreover, a serious blow is dealt at the kinetic theory of gases; this theory no longer accounts for all the facts, and the day may not be far distant when it will have to give place to other views of the constitution of gases.

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* Editorial comment in the *Electrical Review*, London.

What idea, then, are we to form of these cathode rays? It can be no longer doubted that the phenomenon is one which is due to the luminiferous ether. It is very remarkable that the disturbance which the molecules produce depends on their mass alone. There is nothing corresponding to this with ordinary light. Many interesting questions remain yet to be answered. Why can the rays be produced only in rarefied gas? Why under conditions so different from those under which they may be propagated? What is the state of tension of the ether inside and outside the producing apparatus? The solution of these questions will be of the greatest interest. One cannot help thinking that these questions touch the inner mechanism of luminous and electric phenomena, and it is not too much to hope that here will be found the point of view from which a better comprehension of these phenomena may be attained.

LONDON NOTES.

(From our London Correspondent.)

THE CHLORIDE ELECTRICAL BATTERY.

Some important litigation has been commenced over here by the Electrical Power Storage Company, Limited, who have applied to the courts for an injunction restraining the Chloride Electrical Storage Syndicate, along with whom are Messrs. Mather and Platt and Dr. John Hopkinson, from continuing "a breach of the great patent for secondary batteries," by manufacturing and selling what the plaintiff company assert are batteries infringing their patent. I understand that the defendants in the action contend that they are fully justified in making and using these cells, and they intend offering a very strenuous resistance to the claims of the E. P. S. Company. The defendants have arranged to indemnify all purchasers or users of the cells supplied by them against all action of the plaintiffs. The plaintiffs have retained most eminent counsel in Sir Richard Webster, and the defendants will also be well represented. The plaintiffs' patent really expires in the early months of 1895. The action is being interestedly watched in this country.

DETERMINING THE ELECTRO-MAGNETIC CAPACITY OF A CONDENSER.

Before the Physical Society of London, on November 23, a Paper was read on "A Modification of the Ballistic Method of Determining the Electro-magnetic Capacity of a Condenser." The condenser is placed in parallel with one arm (S) of a Wheatstone bridge arrangement of non-inductive resistances. A balance for steady currents having been obtained, the condenser is placed in circuit, and the throw on depressing the battery key determined. The condenser is then thrown out of circuit and the proportionality of the arms of the bridge disturbed by changing the value of S to S + dS. The steady deflection due to this change is then read. From these two readings and the known values of S and dS, the capacity is immediately determined. In practice, readings of deflection may be taken with equal positive and negative values of dS. To avoid changes of E. M. F. of the battery, the author finds it best to use a reversing key in the battery circuit, and to observe the throw on reversing the current instead of on simply breaking it. One advantage of the method is that there is no need to know the galvanometer or battery resistance, and the author points out that it may be of service in the simultaneous determination of the resistance and of the joint capacity and inductance of a submarine cable or of a telephone or telegraph line. With regard to the reversing of the battery circuit, that was found to give in practice as nearly as possible twice the deflection which resulted from simply breaking.

BERLINER PATENT VOID.

News is received as we go to press that Judge Carpenter, in the United States Circuit Court at Boston, has declared the Berliner transmitter patent, so long delayed in the Patent Office, to be null and void.

Independent telephone companies now have a practically clear field.

Bell Telephone stock began tumbling at once upon the announcement, dropping ten points in an hour. The monopoly of the company is now broken forever.

SOCIETY NEWS.

American Institute of Electrical Engineers.

The 92d meeting of the Institute will be held at 12 West 31st street, New York City, on Wednesday, December 19, at 8 P. M.

A Paper will be presented by Mr. Ludwig Gutmann, of Chicago, entitled "On the Production of Rotary Magnetic Fields by a Single Alternating Current."

In the absence of the author, the Paper will be presented in abstract by Dr. M. I. Pupin.

A meeting of Western members will be held the same evening, Wednesday, December 19, at 8 P.M., at Armour Institute, 33d street and Armour avenue, Chicago, where the Paper will be read by the author.

Applications have been received from the following candidates for Associate Membership and will be acted upon by Council at its meeting, January 16, 1895:

Subscribers to the Congress Book, who have not already done so, should send in their remittance of $3.00.

Great Western Manufacturing Co.'s Affairs.

At Boston, Judge Morton, upon complaint of the Eastern Electric Cable Company, has granted a temporary injunction restraining the American Loan and Trust Company from disposing of bonds or proceeds of bonds sold and held under an agreement relative to the Great Western Manufacturing Company of Duluth, Minn.

There had been an issue of $100,000 in bonds secured by the plant of the company at Duluth. These bonds were held by the trust company, and $80,000 have been sold. There are $20,000 remaining.

At Duluth, the Merchants' National Bank of St. Paul has asked for an injunction to restrain the company from delivering these bonds to the American Loan and Trust Company of Boston. The complaint sets forth that on November 13, at Chicago, the Great Western fraudulently deeded and mortgaged its property to the Boston concern to secure $100,000 in twenty years pretended bonds that were issued by the president and secretary without the knowledge of the directors and for no consideration. Eighty thousand were delivered. On the 30th ult., the Great Western gave a bill of sale to the Chicago First National Bank of all its property in Illinois and all its personal property in Minnesota, and the Chicago bank's attorney claims possession.

To Utilize the Waste Culm.

An effort will soon be made, it is said, to solve the problem of utilizing the immense culm piles in the anthracite coal regions. There are millions and millions of tons of this culm lying waste. Capitalists with headquarters in Scranton and Wilkesbarre are organizing a company to use the culm for fuel and to establish another great transmission plant, delivering power to the large cities of the seaboard.

ELECTRICITY discussed this subject at some length some months ago, and, as then stated, there can be little doubt but that such a station would possess material advantages on the score of economy over the Niagara water power plant.

The Commercial Possibilities of Accumulators for Tramcar Traction Considered as a Municipal Undertaking.[*]

BY ALFRED H. GIBBINGS.

INTRODUCTORY REMARKS.

During the past twelve months I have had occasion to consider the question of electric traction in each of the many forms in which it is placed before the public in general and municipalities in particular by the interested advocates of the respective systems. The fact is, the Corporation of Hull had it in contemplation to apply for an Act of Parliament empowering them to acquire and work the tramway system of their own borough. I was therefore requested by my committee to place before them a report as to what had already been done in this country in the direction of electric traction, so that at least as far as this form of traction was concerned they would be in a position to consider each of the different methods on its own merits.

In my final report to the committee I submitted that, in my judgment, accumulators would offer greater advantages to the town than either of the other forms. The technical journals, however, in which this recommendation was published did not, I am sorry to say, include the whole of my report to the Corporation. The consequence was (as might, indeed, have been anticipated) that several criticisms were passed questioning the commercial and financial results of the method I recommended, whereas, in fact, these results were the determining factors in the conclusion to which I ultimately arrived.

When the subject of electrical traction is seriously approached by electrical engineers, corporations and companies, the usual course of procedure and investigation is to consider the relative intrinsic merits of the different systems apart from the very important question of the conditions under which the method is to be employed. Each of three forms of electric traction, namely, the underground channel or conduit system, overhead wires or trolley system and accumulators, has its own very able exponents in the technical press and elsewhere, but unfortunately the majority of the writers are themselves interested in the system which they advocate, and for this reason such papers cannot be considered to have the same value as if the authors had been entirely disinterested experts.

I am safe, perhaps, in admitting that the overhead wire or trolley system has proved a greater practical and financial success than either of the others. This statement, however, refers to cases in which a special plant has been put down to generate energy for the specific purpose of working whichever system has been adopted, and as far as my knowledge extends every comparison between the three systems in regard to cost and working efficiency has been made under these special circumstances. I am, however, digressing a little and will now resume.

The recommendation to adopt accumulators which I ultimately submitted to the Corporation of Hull was based upon an entirely new departure, in the working out of which I have been very interested. My object in bringing the subject before your notice in this Paper is that my reasons and conclusions may be fully discussed, in the hope that a new light may be thrown upon municipal undertakings. I have come to the conclusion that the secret of success lies not so much in the adoption of any particular method of electric traction, however superior, as it does in enlisting and utilizing services which other enterprises can be made to contribute. Separately, they may be only just paying their way, but combined it will probably become possible to make an exceptional success of both.

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[*] Paper read before the Northern Society of Electrical Engineers, Manchester, England, December 10, 1894.

Let me clear the way, in the first place, by removing any misconceptions there may be that the circumstances and conditions of the town of Hull relative to electric traction are unique in their nature. Such is not the case. There are, indeed, dead level roads, and these certainly offer many advantages to accumulator traction which might not apply elsewhere. On the other hand, there are many dock bridges which open and close, and these present a mechanical difficulty which, however, can be surmounted without stopping the running of the cars, as it is very seldom that two of the docks' gates are open at the same time. But, in point of fact, these special features do not affect the general question we are considering.

The basis on which I now propose to consider the subject of my Paper has for its essential feature the possibilities in economical management and working which are within the power of municipal corporations. Municipal corporations are, in this respect, widely different from private or public companies, inasmuch as they are responsible, not for one business alone, but for many and varied undertakings. A public company, restricted to the narrow limits of its single enterprise will, of course, select a system which is likely to show the lowest working costs, and such a selection will be to the best interests of the shareholders. But municipal corporations should have wider views. They have many businesses to conduct in the interest of the ratepayers. The system therefore to be selected by a municipal corporation is that which has the greatest tendency to enhance the value and increase the profits of other departments of the corporation. The cost of working, considered from this point of view, though perhaps actually heavy and large, may be *relatively* small.

I will now proceed to a short general analysis of the combination of refuse destruction, electric tramway service and electric lighting on the low tension system.

For the purposes of illustrating the general arrangement I beg to draw your attention to the accompanying diagram. The large circle of lines represents the tramcar route, with the destructor station on the confines of the town, and the electric lighting station in the center.

POWER FROM REFUSE DESTRUCTION.

It is now a generally admitted fact that, given modern improvements for the generation of steam, some power can be obtained from refuse destruction. The publication of Mr. Charles Jones's book on Refuse Destructors has thrown light upon a subject which has hitherto been neglected by engineers, while the popular articles by Mr. Thomas Thomlinson have brought new possibilities before the electrical engineer.

To sum up the whole of the evidence contained in Mr. Jones's work I find that out of fifty destructors at work destroying from 3½ tons to 10 tons per cell, the power obtained varies from 5 to 7 H. P. per cell. This power has been generated under conditions for raising steam which have had to be and will always have to be modified and made compatible with the complete destruction of the refuse from a sanitary point of view.

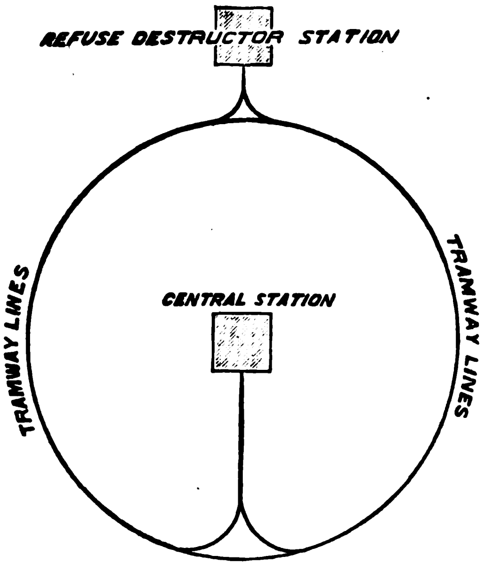
The question therefore arises : What is the best use to which this power may be put ? Hitherto it has found its solution for the most part in the working of mortar mills and stonebreakers, or as a subsidiary power to an electric lighting station, possibly producing sufficient power for day-load purposes. These applications, however, while their advantages are not denied, do not use one-half of the available power, for the simple reason that most destructors are in operation the whole of the twenty-four hours, and the hot gases are at night perforce turned into a bye-pass flue and so far wasted.

Under every scheme which is at present being tried there is as much power lost as utilized, but in the scheme to which I wish to draw your attention this evening the whole available power is laid under contribution day and night without intermission as far, of course, as the usual engineering considerations will allow.

Now this is a very important point, upon which I wish to lay particular stress.

The difference therefore between my proposition and the use to which the power has already been applied, or, in other words, between my scheme and the schemes for utilizing the power for the day load of electric lighting stations, may be stated as the difference between *horse power* and *horse-power-hours*. The available H. P. with a variable demand is practically an unknown quantity, whereas the utilization of the available H.P. continuously over a stated and prearranged number of hours is a definite quantity and one upon which calculations can be made.

The suggested probable economy in the first case is a very doubtful matter, but under definite conditions the problem is resolved into calculating the usual losses which always occur through the transmission and transformation of power. Where the power is utilized as an auxiliary to electric lighting one other very serious drawback occurs which I just briefly point out in passing. I refer to the "standing by" of the main boilers and their consequent daily cooling during the time that the destructor boilers are supplying steam. The period of the earning capacity of the former is thereby rendered very short, and the increased economy of working by the combination is practically neutralized by being swallowed up in interest on the capital outlay. In addition the boilers are deteriorated by being alternately cold and hot.



APPLICATION OF THE POWER.

In a paper of this description it is quite unnecessary to deal in a detailed manner with all the applications to which it is possible to put the power derived from the destruction of refuse. The effectiveness of this power depends largely on the quantity and nature of the refuse to be destroyed and this again varies enormously in different towns. But I have already pointed out that according to the best authorities and our own knowledge of the relative value of fuels as heat producing agents, it must be admitted that a refuse destructor cannot be depended upon without the extraneous aid of other fuel to provide its maximum power at any given time. I must not be understood to say that an advisable and economical arrangement might not be devised where coal, for instance, might be used as an auxiliary fuel, but taking the refuse destructor on its own capabilities alone, we may safely assume that as a power producer it is limited to this extent, namely, *that it yields a mean steady power only*, or in other words, *that it cannot be depended upon for sudden emergencies*. We must take it for granted at the outset, I think, that in every case the refuse destructor may be depended upon to provide a certain *minimum* power. This minimum power must be adequate to meet the demand upon it, or in other words, the plants to which it is proposed to apply the power must be so designed and arranged that *at no time shall a sudden and unexpected demand* be made upon the destructor which it is incapable of meeting.

In the town of Hull about 250 tons of miscellaneous refuse are destroyed weekly. This is a small quantity compared with that of other provincial towns. A large portion is composed of dry shop-refuse, such as paper, straw, wood and ashes, while it is not an infrequent occurrence to have to destroy whole ship cargoes of condemned fruits, vegetables and fish. From observations taken I am well within the mark in estimating that with the necessary alterations to the present destructor we could obtain a continuous power of 45 I. H. P. This 45 I. H. P. would give at least 40·5 E. H. P. at an efficiency of electrical machinery of only 90 per cent., or a continuous output of 400 amperes at 75 volts, for it must be borne in mind that under the scheme I am unfolding the electrical machinery would be designed to always work at full load. This arrangement would be amply sufficient to charge batteries of 25 cells, always keeping a certain number of batteries in parallel according to the rate of charge.

Of course, the number of batteries and their size would depend upon the size of car to be propelled, and I have already pointed out that the power at the destructor station can be supplied continuously for the twenty-four hours. This would be equivalent to doubling the capacity of the plant, as the batteries charged during the night would meet the requirements of the tramcars for half the succeeding day. This power would charge a sufficient number of accumulators to run from about one-half to three-quarters of the trams according to whether the service consisted of twelve or more trams in the hour on the different routes. The remaining portion could be conveniently and economically provided for by supplying another charging station with power from the machines at the central electric lighting station, which machines would be available for this purpose during day or night excepting only at the time of maximum demand.

In considering the whole matter I had brought before my notice what had already been done with regard to thermal storage. There may be possibilities in thermal storage which are not yet matters of common knowledge. This of course may be especially the case where sudden demands for abnormal power for short periods would be made, as in that case the steady and continuous power generated might be stored.

But the only reliable working statistics we have are those connected with a steam tramway in India, where the engines obtain sufficient power for one journey from a reservoir of high-pressure steam. It can easily be seen, however, that the hot climate of that country must conduce very largely to the success of the system, as radiation must be at a much less rate than would be the case in England. Indeed an English winter might render such a system quite inoperative.

Reverting to the two other alternatives, namely, the Overhead Cable or Trolley System and the Underground Conduit System, the *advantages* of which mainly consist in economy of working (plant for plant), I may mention a few of the *disadvantages* (and consequent expense) attendant upon these systems which do not occur with the use of accumulators:

1. Irregular demands upon the generating plant.

2. Greater wear and tear of the machinery.

3. Capacity of generating plant must be equal to all possible demand upon it.

4. Plant standing idle when cars are not running.

5. Stringent requirements of the Board of Trade as to insulation and periodical tests.

6. Greater original outlay of capital.

7. Impossible to economically use the power which the electric lighting station might contribute during the day.

8. Inability of the refuse destructor station to supply *the whole of* the power required, hence,

9. Necessity to erect independent central generating station to supply *additional* power required.

10. For reasons contained in 8 and 9, very little, if any, advantage in point of economical working would arise from the aid of the refuse destructor.

The foregoing list of disadvantages is serious enough, but over and above all these I may point out that the power from a refuse destructor when applied to an overhead or underground system would only complicate what is merely a simple scheme. In fact it would be more economical to put down one complete generating plant for the tramcars, appropriating the destructor power to some other purpose, where, as I have already mentioned, the whole power obtainable as calculated in horse-power hours would be turned to more remunerative account.

The most serious item to be considered is, after all, that of capital expenditure. A heavy original outlay runs away with so much of the profit in the case of municipalities in providing interest and sinking fund. Now the capital expenditure, be it observed, for the complete equipment of accumulator cars is usually from 50 per cent. to 75 per cent. only of that required for the overhead cable system according to the track mileage. If the accumulator system can be arranged and worked so that the entire depreciation of the accumulators can be written off per annum out of lower working costs than are possible with either of the other systems, then it is clear that traction by accumulators would be the most highly remunerative system of any form of traction yet devised.

(*To be continued.*)

Mr. William Brock, of Paterson, N.J., intends to show all the uses to which electricity can be put. He is having a home built for himself, and expects to have it completed in a few weeks. He will apply electricity throughout his domicile. The house will be heated by electricity, the cooking will be done on an electric range, the house will be cooled in summer with electric fans; there will be a burglar alarm connecting with every part of the house, electric annunciators, and the whole, from cellar to garret, will be lighted by electricity. The house will be so arranged that should it be invaded by a burglar an alarm will be given to the family when on the floor above, and by means of a switch the whole lower part of the house can be flooded with light. Should the burglar attempt to escape from one room to another or out of the doors he will give the alarm by stepping on mats that will give notice of the intruder's movements and whereabouts.

The Mt. Lowe electric railway, which, supplemented by a wonderful cable incline rising 1,300 feet in a length of 3,000 feet, takes sightseers to the summit of Echo mountain in the Sierra Madre range, a few miles from Pasadena, Cal., and gives them a succession of magnificent views of mountains, orange-growing plains, scattered cities and villages and the distant Pacific ocean, is to make another long push upward.

Popular Electrical Science.

V.

Locating a Bullet in the Human Body—Detecting Counterfeit Coins—Testing the Acuteness of Hearing.

BY NELSON W. PERRY, E. M.

The principle of induction, whereby an alternating or variable current in one wire or coil induces a similar alternating or variable current in another entirely disconnected from but parallel to it, by means of the ethereal waves set up by the first, as explained in the third article of this series, is the foundation of a long line of extremely useful and interesting devices. I stated in the article referred to that rapidly alternating currents could not be detected by the deviation of the compass needle and that resort must be had in such cases to more delicate means. In the telephone we have such an instrument. In fact it is peculiarly a variable current detector, for a steady current, no matter how strong it may be, will give no indication of its presence whatever in the telephone. If the current be caused to vary rapidly in strength or in direction, it becomes one of the most sensitive and delicate instruments in the hands of the electrician, and currents so small and insignificant as scarcely to be recognizable by any other means are readily detected by the telephone if they be given a variable character by interrupting the currents or reversing them at frequent intervals.

Unlike most other instruments of great delicacy, the telephone is nearly as effective in the hands of a novice as it is in the hands of the trained expert, and now that it can be purchased outright for a small sum, or can be made at even still less cost by any one possessed of the slightest mechanical skill, any of my readers can construct for themselves the instruments to be described in this article.

If we pass an interrupted or variable current through a flat coil of wire and bring near to it another similar coil in whose circuit a telephone receiver is connected, and place the latter to the ear, every variation of the current in the first circuit will *induce* a slight current in the second coil, and this affecting the telephone the latter will respond with a slight click or other noise. This second or induced current is due to the etheric waves sent out into space by the variable current in the first coil coming in contact with the wires of the second coil, as explained in Article III.

It is a law of induction that the induced current is always opposed to the inducing current. That is to say, if the inducing current is increasing in intensity the current which it induces in the parallel conductor will be in a direction *opposite* to that which it would have were the inducing current decreasing in intensity.

If now, as in Fig. 1, we have in our primary two coils E E' and in our telephone circuit two other coils F F', all four of which have exactly the same number of turns of wire in them, the coils E E' may induce currents in F and F' either in the same direction or in opposite directions according as the coils F and F' are wound in the same or opposite directions as the adjacent coils E and E'.

If the coils F and F' are wound so as to have currents induced in them in the same direction, the noise in the telephone will be intensified. If they are wound so that the currents are opposed to each other, the current which will flow through the telephone will be less or equal to the difference between the two. If all four coils are exactly equal and the spaces between the two pairs are also equal, but the coils F and F' are so wound as to have currents induced in them in the opposite directions, the effects on one will exactly neutralize the effects on the other, and no matter how great the waves sent out from E and E' there will be no current in the second circuit and the telephone K will be silent. That is because the induction in one direction of E on F is exactly balanced by the induction in the opposite direction of E' on F'. This arrangement is therefore called an "induction balance" and corresponds very closely to an exceedingly delicate analytical balance, such as is used by the chemists. The telephone will only be silent when the induction effects between the two pairs of coils are exactly equal. An apparently very trifling difference in either of the pairs of coils or their surroundings will destroy this equilibrium and the telephone will respond again, and it is by this response of the telephone that these slight changes in the surroundings are detected.

In making an instrument of this kind four flat spools of guttapercha, hard wood or other insulating material of the same size are taken, and upon each of these are wound exactly the same number of turns of fine insulated copper wire—say 500 or 600 turns of No. 32 wire. Two of these are connected up in circuit with an ordinary galvanic battery or cell C, together with some means of rapidly interrupting or varying the current, D. This may conveniently consist of a small clock upon whose baseboard are two carbon pencils lightly resting the one upon the other. These pencils, if the battery current be caused to pass through them, constitute a most excellent and sensitive microphone, since every time the clock ticks they will be jarred slightly and this jarring will vary the current sufficiently for the purposes sought.

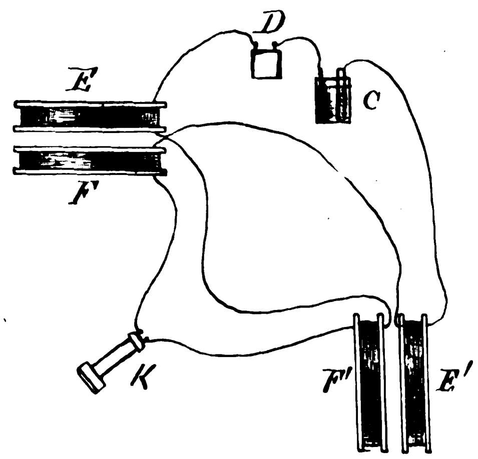


FIG. 1.

The other two coils F and F' are connected up on a second circuit containing a telephone *K*, and F' is laid flat on E' and fastened so that the distance between the two will remain unchanged. With the telephone K at the ear, bring F close to E. When one side of F is presented to E the ticking of the clock will be distinctly heard. When the other side is presented, however, the ticking will be faintly heard or not at all. If the ticking can be heard even faintly, it will be found that by moving F a little closer or further away the ticking sound will entirely disappear—the induction between the two pairs of coils has been perfectly balanced. E and F should now be permanently fixed at this distance, which gives in the telephone entire silence. But this balance is wonderfully unstable, since the slightest change in the surroundings of one pair of coils which does not take place around the other pair also will destroy it and the ticking will become audible again. If, for instance, one pair be hotter or colder than the other by even a slight change of temperature, the ticking will reappear in the telephone. The induction balance then affords a most delicate means of comparing the temperatures of two bodies or of two parts of the same body. Or if a piece of metal or other conductor of electricity be brought near one pair of coils, it will throw the system out of balance and the ticking can be heard again. If a leaden bullet should be brought within say an inch or two of E' the telephone would respond. But if now another similar bullet be brought into exactly the same position relative to E, the disturbance caused by the first bullet by its proximity to E' will be exactly counterbalanced by the disturbance caused by the second bullet in the same proximity to the coil E and the telephone becomes mute. The second bullet must, however, have exactly the same position relative to the second pair of coils as the first one has to the first pair else the balance will not be re-established. We can, therefore, even if the first bullet be hidden and its exact position not known find out its position relative to the first pair of coils by moving a second bullet around near the second pair until the telephone becomes mute. Its position relative to the second pair of coils when this occurs will be exactly that of the hidden bullet relative to the first.

HOW THEY PROBED FOR THE BULLET IN GARFIELD'S BODY.

This induction balance, which is due to Prof. Hughes, has been used in various forms by surgeons as an electric probe to locate the position of a ball in the living body. To employ it for this purpose one pair of the coils is moved about over that portion of the body nearest where the ball is supposed to be. As soon as the coils come near the bullet the telephone begins to respond and becomes loudest when directly over the projectile. Retaining these coils now in this position, another bullet of the same size as the one sought for is moved around in the vicinity of the other pair of coils until the telephone again becomes mute. The distance of the second ball from the second coils will therefore be the distance of the ball sought for beneath the exploring coils.

It must be observed, however, that the exploring coil will indicate the proximity of any other piece of metal as well as that of the bullet sought for. It will not discriminate between the thing the surgeon has in mind and that which he has not, and a gold ring thoughtlessly left on the finger of the operator would in nine times out of ten be located instead of the bullet. This method of probing was tried on the body of the lamented Garfield without satisfactory results, but the very intelligent physicians in charge of the case forgot to remove the patient from the spring mattress and the brass bedstead upon which he was lying, and the electric sound indicated the bullet quite as positively in the big toe of the patient as in the right place. In fact, had the patient been taken out of bed and the test made on the bedclothes the bullet could have been quite as definitely located. With this light on the subject the electric probe, which the sagacious and wise and intelligent doctors condemned as useless and misleading, rises up in condemnation of their own criminal ignorance and malpractice, to which probably as much as to Guiteau's bullet was due the nation's mourning.

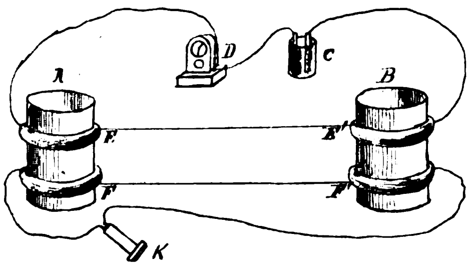


FIG. 2.

The philosophy of this effect of a mass of metal or other good conductor of electricity upon the induction balance is this: The alternating currents in the primary coil E' send out etheric waves in all directions. Those which are intercepted by its companion coil induce currents in the circuit to which the telephone is attached. Those which go out in other directions in like manner develop oscillating currents in any other conductors with which they come in contact, and the strength of these induced currents, other things being equal, will depend upon the conductivity of the substance encountered by the waves. They will be stronger as the substance encountered is a better conductor of electricity. When these oscillations become of appreciable strength, as for instance in the bullet when it is brought near to the primary coil, they set up little waves of their own which spread out from the bullet as a center in increasing circles, and these secondary waves coming in contact with the original coil tend to produce oscillating currents in that coil in the opposite direction to those that have been purposely impressed upon it by our battery and microphone. They *dampen down* the original waves in that coil therefore, and by weakening them throw the system out of balance, the induction between the coils E and F, which by their greater distance are less affected, overpowers that between E' F' and the telephone responds.

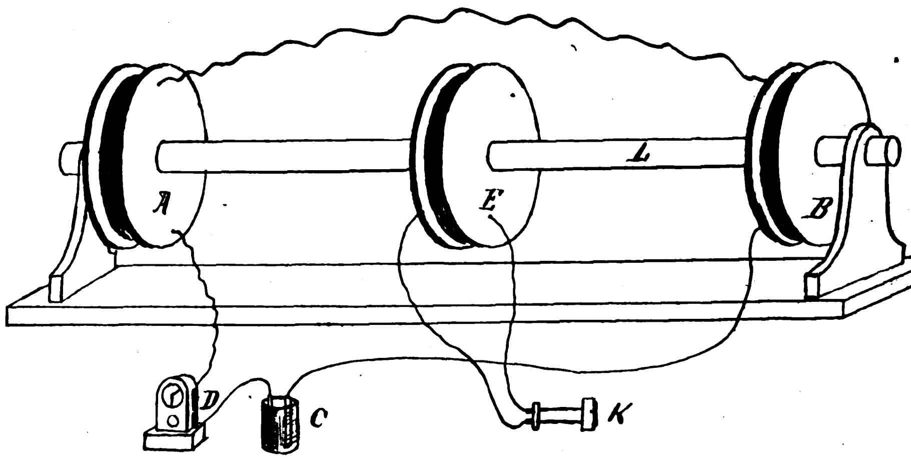


FIG. 3.

This device has also been used as a submarine finder by lowering one pair of coils to the bottom of the sea and trailing it around. The presence of torpedoes or other metallic bodies is in this way readily indicated. It has even been proposed for use as a divining rod to locate ore bodies beneath the surface of the earth, but as few of the metallic ores are good conductors of electricity, and those that are are usually so disseminated over large areas, the indications of the induction balance are in such cases apt to be more misleading than reliable.

DETECTING COUNTERFEIT COINS.

A very simple modification of the instrument just described adapts it to the detection of counterfeit coins in an infallible manner, and the construction is so simple that almost any one can make it. In fact it seems strange that some manufacturer has not already put such a detector upon the market at a price that would bring it within the reach of all. Such an instrument is shown in Fig. 2, and is identical with the one just described except that the two pairs of coils are wound not upon spools but upon guttapercha or other non-conducting cylinders A and B. The different parts are lettered exactly as are the corresponding parts in Fig. 1. E E' are the two primary coils in the circuit in which are connected the battery C and the microphone D. F F' are the other two coils, called the secondary, and the system as before is balanced up by moving the coils E F nearer or further until the telephone K becomes mute.

Now, if we place a silver coin in the cylinder B it will at once throw the system out of balance for the same reason that the proximity of the bullet did in the former arrangement. We may balance the effect of this coin by putting an exactly similar one into the cylinder A. If, however, the second coin is not exactly similar to the first—if it be lighter or heavier in weight, if it be of purer or less pure material, if it be of an entirely different substance, the balance will not be complete. Thus a gold coin will not balance a silver coin of the same size, nor will a silver-plated coin or a light weight coin balance a genuine one. Therefore, to detect a counterfeit, or light weight coin, it is only necessary to place one known to be genuine in one cylinder and the suspected one in the other and then apply the telephone to the ear. If the ticking of the clock can be heard distinctly, there is unquestionably something wrong.

The dimensions recommended for such an instrument are as follows: Each of the coils should have about 150 turns of wire and the two coils of each pair should be about ¼ inch apart. The cylinders should be large enough to hold the largest coin likely to be tested, or a trifle larger in diameter than a silver dollar. They need only be high enough to give room for the coils. The bottoms should be such that when the coin is lying down flat it will be equidistant from both coils, and this distance should be nearly the same in both cylinders.

A balance thus constructed is so sensitive that different results are obtained even when the physical condition of the coin only is altered, as for instance by hammering.

TESTING THE HEARING.

Still another modification of the induction balance adapts it to another class of investigations requiring great delicacy, but which by its use are brought within the reach of every one.

Aurists have long been in need of some standard by which to compare the acuteness of hearing of their various patients, or by which to measure the progress of recovery. In this way, also, electricity comes to their aid, and one form of the instrument used is indicated in Fig. 3. It will be recognized at once as another form of induction balance. A and B, as before, are the primary coils so wound as to oppose each other in their inductive effects. D, the microphone, and C, the battery, perform the same office as in the previous apparatus and are connected up in the same way. But A and B are fixed in position at either end of a metal rod L, preferably of soft iron, because, as we have seen, soft annealed iron propagates the etheric waves with much greater facility than any other substance. A third coil E, in whose circuit is a telephone receiver K, is also placed on this rod, but is loose so that it can be moved along towards either A or B as desired. If now the two primary coils are connected up so that their inductive effects oppose each other, there will be some position of E on the rod where the effects of one will exactly counterbalance the effects of the other, and the telephone will be silent. If A and B are exactly equal, that point will be midway between the two. If they are unequal, that point will be nearer the weaker coil. The iron rod may conveniently be graduated according to any arbitrary unit, and the point at which the telephone becomes silent marked zero, the graduations being numbered both ways from this point. To test one's hearing the telephone is placed at the ear and the secondary coil E moved toward either A or B, until the patient can hear the ticking of the clock and the number of the division on the rod at which the sound becomes audible noted. This number indicates the sensitiveness of that particular ear. Placing the telephone now to the other ear, a very slight difference in sensitiveness may be detected by the necessity of moving E one way or the other to get the same audible results. So, too, the same ear may be tested at widely different times, with certainty that any change for the better or worse will be detected. If A and B be exactly alike, as they should be, their effect upon E in whatever position the latter may be in will be practically the same whether the current flowing through A and B be large or small, for the resultant effect on E is under these conditions the *difference* between the effects of the two coils separately, and the adding to or subtracting from these two quantities the same quantity does not affect their difference.

Since the telephone has become public property the market has been flooded with telephones of different makes, each claiming to be superior to all others. Dealers and users have generally had no means of comparing their relative merits and have had to rely upon the statements of the manufacturers, who have perhaps themselves had no means of knowing accurately how their instruments compared with those supplied by their competitors. If in the above instrument we let the ear remain the same, but change the telephones, we can readily compare their efficiencies by noting how near the neutral or zero point E can be moved and still produce audible results in the telephone.

An Electrode Sensitive to Light.

In the *Zeitschrift für Physikalische Chemie*, H. Luggin describes a new form of electrode which he claims to be much more sensitive to light than any that has hitherto been made use of in previous investigations. Briefly, its essential features are as follows: A plate of platinum is coated with silver bromide and is then duplicated with a similarly coated platinum plate in an aqueous solution of bromide of potassium (decinormal). A quadrant electrometer of the usual type is employed in observing the rise of potential. Luggin states that in some of his experiments exposure to diffused daylight was sufficient to cause a rise of potential of 0·5 volt, thus demonstrating the great usefulness of this new form of electrode. When illuminated by any weak light it appears that this electrode shows a rise of potential which is uniform, and can be represented graphically in a system of coordinates by means of a straight line until a maximum is reached, after which it remains constant or may show a slight fall. The rate of increase of potential is much more marked when stronger light is employed, but for all that the maximum value attained is not higher. The rate of rise, however, is not directly proportional to the intensity of the impinging light, whilst it is also lowered by a previous exposure of the electrode to a powerful light. Continuous and intermittent lights of the same intensity do not appear to produce the same effect on the potential. These plates, though ingenious and likely to become exceedingly useful in certain investigations, do not remain constant as regards their sensitiveness, and even after long rests they show with the same sources of light very different increases of potential. Therein, we presume, consists their only weakness.—*The Electrical Review* (*London*).

DIRECT CURRENT MOTOR AND DYNAMO DESIGN*—II.

BY GANO S. DUNN.

The next feature I wish to speak about is sparking and armature reaction. Sparking is the phenomenon of sparks at the brushes of a direct current machine due to the self-induction of the coils. There are a number of forms of sparking which are not due to that at all. If this commutator were full of ridges it would spark; but those can be easily turned off. If the brushes are too small it will spark; but they can be made larger. These are not inherent difficulties; they are merely matters of construction. But if we construct these at our best, we will always have the sparking which I have just defined, due to the self-induction of the coils. The reason for that you are familiar with. It is shown in the diagram, Fig. 5. It is at the moment of change of the direction of the current that we get the spark, the same as we do in an induction coil when we start or stop a current in it; and this coil has a certain amount of electrical inertia that will not submit to being reversed suddenly. It has got to take a little time and the spark shows. Now a large portion of the design of direct current machinery is nothing else than provision that the machines shall not spark. There are two methods by which we can stop the sparking. The first method is by forced commutation. The second method is by means of an electromotive force applied to the coil which is at the moment having its current changed. This electromotive force helps to change quickly. Forced commutation is the means of killing the spark by resistance of brushes. The coil A, Fig. 5, has no current in it. But as the armature is revolved pretty soon the toe of the brush will leave the commutator bar *b*. Then the brush will bear only upon the commutator bar c. Thus, half the current will be obliged to go through the coil A in order to get through that half of the winding marked L, and the other half will come down to B as usual. Now if that coil A can be prepared so that when its turn comes to take its place with the rest of the winding it can have the current already flowing in it of the same quantity as the current in its new position, then on leaving the toe of the brush, at that bar B there will be no sparking. That can be done in forced commutation by having the resistance of the brush sufficiently high. As the commutator moves and the brush touches less and less of the bar *b*, the current finds it harder to get into this commutator bar than into *c*, so it begins to overcome the electrical inertia and go up the coil A gradually from *c*. By the time *b* has moved from under the brush the whole current will have been gradually throttled to go out of bar *b* and forced to go up into the coil A and there will be no sparking.

To put carbon on some machines is very bad, because it has so very much higher resistance than copper that it uses up the power of the machine, and therefore other materials have been very much sought for. The copper brush is made of many laminæ, so that the current that comes down through the brush cannot all get squeezed into that little toe. It cannot get into that toe unless it is started into it at the top of the brush, and if it is started into it at the top there is an appreciable resistance. If that resistance is not enough, we resort to the copper gauze brush, which has a much higher resistance than a copper leaf brush, and while there are some mechanical advantages in using it, such as cooling effects, yet the principal reason it stops sparking is that it has higher resistance. If this resistance is not high enough we go the next step, which is a brass gauze brush having about twice the resistance of copper gauze. If that is not enough we take the next step. That is some form of carbon which has its resistance reduced. Ordinary carbon cannot have its resistance reduced. But all sorts of inventions have been made, such as putting fine filings in the brush, and in this case the brushes are made with layers of gauze molded in them, so that the gauze helps to increase the conductivity of the brush. After that comes the pure carbon, and if that is not of high enough resistance it can be made as high as desired by mixing clay with it. The resistance of brushes ought to go up as the voltage of the machine goes up. I have had in mind, but have not had the time to carry them out, experiments to determine just what the law is. I believe it should go up as the square of the voltage and that by making our machines on that basis and considering the resistance of the brushes just as much a part of the design as we do the resistance of the armature windings, we could build very large machines of very high voltage without sparking. I do not see why the resistances could not be just right so as to squeeze all of a 10,000 volt current over into the bar following before the break takes place.

In connection with this there is one thing that we have forgotten. If we do that squeezing and throttling, it heats the commutator, and if the commutator is too small its temperature rises. It decomposes the carbon brush; the commutator gets black and the machine is rendered unfit for use. If you are going to determine on forced commutation you must then have a definite ratio of commutator surface for every horse power in your machine. That is as true as the fact that the resistance of your brushes should go up with your voltage.

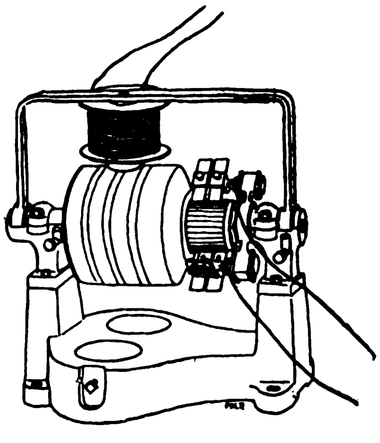


FIG. 6.

So much for forced commutation. The other method of stopping sparking is by applying an electromotive force to the coil A, just as it comes out of circuit, so that by the time it comes into circuit it shall have its current. Applying electromotive force means that you have a little dynamo working to get up the current so as to have it ready. Now that electromotive force will be applied by the magnet held in my hand, and I will endeavor to show you how it will work. [Mr. Dunn started the machine.] This is an armature which has not any field acting on it at all. It seems to me that sparking can be understood better if we talk about it entirely separated from the field magnets. So I have an armature here which is simply revolving in the air. Now I am going to pass its normal current through it and will show you that it sparks. This has not forced commutation because it is a copper brush. Neither is it prevented from sparking by the electromotive force, because there is none acting upon it. To spark is the normal, natural condition of the armature. I have here a carbon brush which will stop the sparking by virtue of its resistance and will be an example of forced commutation. You see the sparking is killed by virtue of the resistance of the carbon brush.

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* Lecture delivered before the New York Electrical Society November 27, 1894.

Now I will show a method of killing the spark on this copper brush by means of the electromotive force applied.

I have here a magnet, Fig. 6, which is energized from the circuit and which will throw out a few lines of force. I will apply it to the armature in the region of the brush and you will see the sparking disappear. (The armature, Fig. 6, is supposed to be driven by another motor.) It may happen that the polarity of this is wrong when I put it on, and it may make the current in the coil go the wrong way so that when it is thrown into circuit it will have to stop the current that is flowing wrongly and then start a proper current and the sparking will be increased. [The polarity was wrong and the sparking was much increased.] I now change the polarity so that it is right, and you see the sparking disappears.

Now I am going to give this not quite enough electromotive force to bring its current equal to the current in the rest of the armature. I will do that by moving the coil a little to one side. The sparking appears again. Now I am going to give it too much, so that the current generated in the coil under the brush is too big for the rest of the circuit. Now it is equal to it and there is no sparking; now it is too big, and the sparking appears again.

Sometimes it happens that an armature with brushes at the neutral point sparks worse than it would if it were let alone. This is because the magnetism from the opposite pole comes over and increases the spark. It is drawn over apparently by the revolution of the armature. That condition can be imitated by reversing the polarity in this coil. I will first reduce the sparking to zero by this electromotive force. Now I will reverse the direction in the coil. The effect is vicious sparking.

You have seen how an electromotive force will stop sparking and you have seen how resistance in the brush will also do it. Now the commutation of every machine that is built takes place by means of one or the other or a combination of these devices. The larger the machine, the more difficult it is to adopt forced commutation because the excessive heating of the brushes causes the commutator to overheat. To design a dynamo so that it will not spark—a dynamo of any size—is merely so laying its magnetism that it will always get a little squirt of lines of force right in the brush. Now you see me moving this coil towards its brush to stop the sparking. But what you do in an actual case—you cannot move the magnets or you cannot move a little coil like this—is to move the brush so that it comes under the edge of the big magnet of the machine and that accomplishes the same result. That is why shifting brushes stops sparking. It enables you to get a little fringe of magnetism which trails off the toes and does the same thing that you saw this little coil do.

There are reactions that oppose the coil and there are also reactions that oppose this action at the toe of the machine. Before you shift brushes you may have a fringe of magnetism that would stop the sparking if it could get at it. But by the time the brush is moved towards it that motion of the brush has introduced reactions into the circuit which have driven back the magnetism. A very important point in dynamo designing is the providing that magnetism shall not be driven away. To show you one of the reactions that tend to drive away that magnetism the next experiment is arranged.

Here is a motor that would normally run forward. As you see, it has no field coils on it, so any magnetism that it may get to run it will have to come from the armature. Now, as I said, it would naturally run forward if it were working with the magnetism generated by its field. Now I will put the armature current alone through it—its regular current that it would have ordinarily—and you will see how it runs. You see it runs backwards. That is what the armature would do if it could in any motor. The fields have to be strong enough to overcome that tendency, and besides overcoming it to give sufficient magnetism to make the armature go forward. That is one of the things that destroy whatever little fringe we have to reverse our coils and prevent sparking. The machine is now running simply on the reaction field produced by the armature. There are no coils on the machine. This reaction is due to the negative ampere turns of the armature. It is easily calculable, and what we have to do is to make the magnetism that comes up this magnet of such strength that it goes through the big air gap offering so much resistance to it that the little extra resistance offered by that reaction on the armature amounts to nothing in comparison, and so that when the armature offers this resistance we still have our little fringe of lines of force which act as the little coil did to stop the sparking.

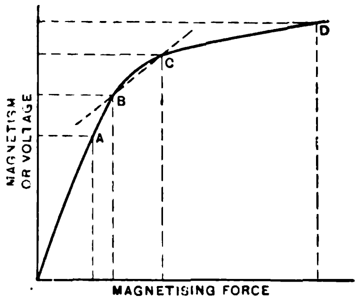


Fig. 7.

In a motor we shift the brushes back to stop sparking, because the proper polarity of fringe comes out of one pole, and in a dynamo we shift the brushes forward to stop sparking because the proper fringe comes out of the other pole.

A method of increasing the resistance of the air gap is, in the toothed armature, to make the teeth very narrow. Here is a toothed armature of a four-pole machine. All the magnetism that gets into this armature has to get into it through these teeth under about 70° of pole piece. You can see that the sum of these teeth is not enough to carry all the magnetism that would go through that core. The result is that the magnetism is squeezed so hard that the reaction of the armature does not amount to much. This effect, that I showed, of a motor running backward, will do the same thing as the differential winding attributed to both Ayrton and Perry and Sprague will do. If the conditions are right we could have a motor, even with field coils on it, such that its reaction will be such in proportion to the effect of these fields, that while the armature will not run backwards when the load comes on yet it will so weaken the field magnets that the armature speed will increase. I have known instances of this, and it can be secured by a little proportioning of the armature very easily and without any other winding. All the benefits, whatever they are, of the differential winding of Ayrton and Perry and of Sprague could have been secured by proportioning their armatures without going through the expense and trouble and elaborate calculations of the differential motor winding.

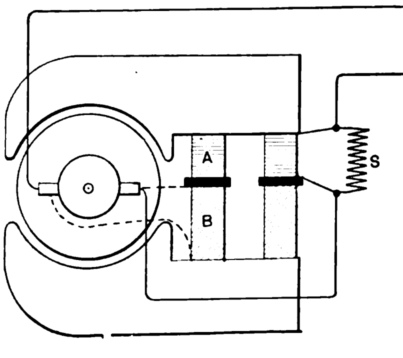


Fig. 8.

One more feature that I wish to call your attention to relates to compound winding of dynamos. That problem is a serious one and is more so than it used to be. A compound wound machine, as you all know, is a machine which, when the load comes on, instead of having its pressure fall off a little, as everything does—steam engines, water wheels, all slow up and pull down a little bit when the load comes on—will have its pressure rise a little. This rise is for the purpose of compensating for loss of pressure in the line. Now if you are lighting a number of lights at a distant point, and when you have all your lights burning, let us assume that you get 10 per cent. less pressure at your lights than you would if you had only one of them burning, a compound wound dynamo can be made so that as fast as the pressure falls, (due to—call it friction of the current in the wire,) the dynamo increases its pressure to make up for that with the result that your lights have always a constant pressure. The voltage at your dynamo rises but your lights are constant. We ought to have this so that at half load the increase of potential would be half of the increase that we have allowed for, and with three-quarters it would be three-quarters, and at full load it would be the full increase. That is impossible to attain exactly.

The use of voltage must be attained by increasing the magnetism of the machine as the load increases. Suppose we want an increase of 10 per cent. in voltage. If we start at C, Fig. 7, we can increase the magnetism and at D will have 10 per cent. more magnetism than at C. But notice at what a sacrifice we have had to more than double the magnetizing force. Not only does that reduce efficiency, but it means double the amount of copper. But the curve from C to D is straight and at half load we get half the increase of potential and at full load a full increase.

If I should work in the region between B and C then at half load we would get a good deal more than half the increase of potential wanted. So we cannot work on that part of the curve; that would injure the lights. Now if we work down on the point of the curve where it is straight again from A to B we secure the results of an even increase of potential. But here we have a machine which we are working at a saturation B and all the capacity from B to C is wasted. In other words, we have to use considerably more iron in that machine in order to saturate the iron at so low a degree as will allow its curve to be straight, and that makes the machine much more expensive and less efficient, because we have copper wire around that iron which gives rise to a great many disadvantages. Now I have devised a method for enabling this portion of the curve B to C to be used with a straight rise of potential. The custom of builders is shown in Fig. 8. One engineer will specify that he wants a 2 per cent., another a 3 per cent., another a 4 per cent., another a 7½ per cent. increase of potential. The manufacturer cannot meet all those demands, so he winds every machine for, say, 10 per cent. increase of potential, and Fig. 8 represents a machine so wound. Those coils B are the shunt winding. Those coils A are the series winding. The current as it comes out of the armature goes in around the series windings and then out to be used. It will be seen that at no load the series coil is not excited at all, while at full load it gets a good many amperes through it and that increases the magnetism enough to make up for losses and raises the potential. If this machine is wound for 10 per cent. over-compounding and a user orders 5 per cent. over-compounding, it is the custom of the manufacturers to insert a shunt S; whereas the whole current would, previous to the addition of the shunt, have gone through the coils A and out and given 10 per cent. increase; now the current divides equally between the coil and shunt and gives only 5 per cent increase in the magnetism. It has been customary to make this shunt of some material whose resistance is fixed, so that if a user ordered 5 per cent. he would get a 5 per cent. distribution at all times, and it was considered bad to have this changed. The shunt was also made very large to keep it cool. By making this shunt, not of german silver, as is customary, but of iron, which has a very high temperature coefficient, and then, instead of making it large, making it very small, so that a small amount of energy will heat it up and change its resistance as much as possible, we can at full load throw into the series coils a good deal more than the proportion they would get at light load. That extra current, if the increase of magnetism were proportional to increase of magnetizing force, would tend to make the increase of potential follow a curve convex downward. Now the increase of magnetism tends to follow a curve whose convexity is upward and the shunt tends to go up, so the result is the potential rises along a resultant of these two, which can be made a straight line. But there is this proviso—you must wait for the shunt to get hot. If you put a sudden load on the machine for five seconds and then take it off again the rise of potential will follow the straight line. We could inclose the shunt in a vacuum so that it would reach its temperature in half a minute. If the generator were for lighting, the load would not change suddenly and therefore the increase of potential could be counted on to be practically proportional.

(To be continued.)

Change in New York Wiring Regulations.

The following amendment to the rules and requirements of the New York Board of Underwriters for the installation of electric light and power have been adopted :

Interior Conduits.—Rule 22. *e*. Add to clause—" Unless the said two separate conductors or twin conductor having an approved insulation are enclosed in a complete, fully insulated, continuous iron conduit, and are in circuits installed as per table of Capacity of Wires (see Section 25), for currents not to exceed 100 amperes."

Rule as amended.—Rule 22. *e*. Must not be supplied with a twin conductor or two separate conductors, in a single tube, unless the said two separate conductors or twin conductor having an approved insulation are enclosed in a complete, fully insulated, continuous iron conduit, and are in circuits installed as per table of Capacity of Wires (see Section 25), for currents not to exceed 100 amperes.

We Give Them What They Want.

The following, from the manager of one of the largest central stations in America, is but a sample of several dozens of letters which we have at hand in regard to our recent article on the Welsbach light :

To the Editor of ELECTRICITY.

DEAR SIR : We are in receipt of copy of the last issue of ELECTRICITY, and note what you say in reference to the Welsbach burner. This is the most comprehensive statement of the matter I have seen, and I will be pleased to have you send me fifteen copies of the paper, with bill for the same. I want them for use of our directors. Articles of this kind are directly in line with what I would have recommended in answer to your letter sent me some days ago. To popularize your paper, if articles were written in the same comprehensive, intelligent manner as is this, it would suit men in my position immensely. Of course you appreciate the fact that I am in no sense an electrician, hence the technical articles are of little account to me. It occurs to me that there are very few technical electricians in the management of electrical plants, and what that class of men wants is a concise, businesslike statement of facts with the X Y Z eliminated. I have no hesitancy in sending your article out to our directors, who are in no sense technical, knowing that they will fully appreciate the merits and demerits of the Welsbach burner.

Improved American Carbons.

To the Editor of ELECTRICITY.

DEAR SIR: I am very much indebted to you for your kind inquiries in reference to our new product, and beg to inform you that the foreign manufacturer has had a monopoly on cored carbons in this country, as our people have been unable to get them at home. The American Central Stations have been clamoring for an "American" cored carbon equal to the best, and we can now assure them, through you, that our "Helios" carbon is the very same "Helios" carbon that they have been buying in Germany. It is made of the same ingredients, in precisely the same way, by the man who made them in Germany. This gentleman, now associated with us, and in charge of our new cored carbon factory, has had eleven years' experience in Germany in the manufacture of these carbons, and you will understand that we know just what we are doing and are taking no chances.

It will be no news to you that previous attempts had been made to produce a satisfactory cored carbon, but failure resulted in every case. Last spring we were led to believe we had found the right method, but when we looked into the "Helios" saw we were on the wrong track.

I am quite certain that this statement from us will be of interest to the electric lighting interests generally, and hope and believe that our people will stick to the Americans who have had the courage to take hold of this problem.

We have been much interested in your exposition of the weak points of the "Welsbach light," and are sure you will appreciate how little show the "Welsbach burner" will stand against an arc light using these cored carbons.

I thank you very much for the opportunity to make the above statements. Yours truly,

JAMES S. HUMBIRD, President.

Pittsburg, Pa., December 12, 1894.

It is a matter of congratulation that we are now enabled to manufacture electric light carbons in this country equal in quality to those made abroad. It has long been appreciated by electric light men that, for the low tension direct and alternating currents especially, only the very best carbons were good enough, and for this reason our importations from abroad have been on an increasing scale notwithstanding the greater first cost of the carbons imported. This has shown conclusively that a better article than that manufactured here has been demanded and that the trade will pay a higher price for a suitable article. In the manufacture of carbons there has been no unity of action in this country, each manufacturer experimenting independently and keeping his results a trade secret. In these investigations doubtless the same ground has been many times threshed over and none has been able to benefit by another's work except in so far as a better product from a competitor stimulated him to renewed exertions to a higher attainment.

It would seem at first sight that given a sample of a good carbon it would be a simple matter to duplicate it. The skill of the chemist would reveal its exact composition, both qualitatively and quantitatively, but chemistry will not disclose the manipulation necessary to produce those results in duplicate. It is unthinkable that Germany or France or England should have better crude material than we have. We do know, however, that generally speaking these countries are more painstaking than we are, and in this we are satisfied lies the whole secret.

Mr. Humbird has adopted the correct plan for producing carbons equal to any in the world, and American central station men will not, we are convinced, be slow in expressing their appreciation of his efforts.

Personal.

Mr. W. F. Mottram has returned to the scene of his former activity in Texas. He will locate in Dallas, and will represent among others the Interior Conduit and Insulation Company and the Walker Manufacturing Company.

Boston Notes.

With the approach of the Christmas season, the stores in Boston are assuming their gayest and most brilliant holiday attire. For several years past electricity has played a very prominent part in the display but never before has it lent itself to the same extent as now. Not only are many of the stores transformed into places of splendor, both externally and internally, but many of the theaters and other places of amusement are so gorgeous in the scintillating rays of electric lights that they attract nightly large crowds of wondering and admiring sightseers from the surrounding districts. The illuminating effects on some of the taller buildings are visible eight and ten miles away. One scene especially is novel and attractive. That is a realistic reproduction of the Peary Expedition in the Arctic regions, where amid towering icebergs and wide-spreading reaches of floe ice, the steamer Falcon is seen laboring to escape being crushed in the ice, and troops of moving Esquimaux are busy along their inhospitable shores fishing, hunting and trading, with a splendid aurora borealis of various and ever-changing tints, produced by a combination of electric lamps and motors, forming a *tout ensemble* that fascinates and delights both old and young. It occupies the whole of an enormous window in the leading dry goods store, and took the designer and his corps of assistants no less than five months to construct.

The Bristol County Electric Railway Company is likely to be the future title of a combination of systems that will include every road now running or to be built throughout southeastern Massachusetts.

The Lombard Water Wheel Governor Company of Boston is manufacturing and installing a new device for the governing of water wheels that bids fair to out-distance anything of the kind ever yet attempted.

There will soon be introduced to the ladies of society, by a Boston electrical firm, a variety of domestic articles electrically heated that are sure to come into quick demand. Among them will be swansdown comforters, Turkish bath towels, foot warmers, hot water bottles and other auxiliaries to the boudoir and toilet room.

The New England office of the Fort Wayne Corporation is securing orders and shipping apparatus to all parts of the East at a rate calculated to make the directors of the General Electric Company feel blue. Mr. E. I. Garfield has surrounded himself with a corps of the best salesmen in the entire electric field, and their hustling is bearing substantial fruit.

General News.

What is Going on in the Electrical World.

Lowell, Mass.—The new electric railway line from Lowell to Lawrence has been opened for traffic.

Elgin, Ill.—The Dundee Rapid Transit Company of Elgin has assigned to M. H. Thompson of this city.

Boston, Mass.—The Edison Illuminating Company of Boston purposes increasing its capital stock $425,000 to $3,425,000.

Cleveland, Ohio.—Messrs. E. S. Ford and S. J. Smith have formed a copartnership for conducting a general electrical engineering business with offices in the Wade Building.

Chillicothe, Mo.—The electric light and waterworks plant has been sold under foreclosure to George M. Meyers, of Kansas City, Mo., who represented the bondholders.

Kingston, N. Y.—The opening of the Colonial City Electric Railroad was celebrated here on the night of the 12th inst. by a great public demonstration. Many stores were illuminated.

Hudson, N. Y.—The Hudson Electric Railway Company, H. McGonegal president, has asked the common council for permission to construct and operate an electric street railway in this city.

Stowe, Vt.—The bill to incorporate the Mt. Mansfield Electric Railroad Company has passed the Legislature and is now a law. The company is about to be formed with a capital stock of $300,000.

Burlington, Vt.—The electric street railway system of Burlington is now operated by power furnished under contract by the Burlington Woolen Company which has an electric plant run by water power.

Norwalk, Ohio.—The Co-operative Construction and Supply Company will soon be reorganized. They have secured a local franchise for power and light, and so will be in the market for electrical construction supplies.

Hot Springs, S. D.—A franchise has been granted by the city council to Pennsylvania capitalists for an electric street railway through this city. It is to be completed and in running order by July 1, 1895.

Lynchburg, Va.—The city council has rescinded its recent action in granting a five-year contract to the Lynchburg Electric Company for lighting the city, and referred the matter to a committee to advertise for bids, etc.

Batavia, N. Y.—A franchise has been granted to the New York Construction Company to build an electric street railway in this village. It is provided in the grant that it shall be a first class road with all the modern improvements.

Manchester, N. H.—This city will soon have one of the best equipped electric street railways in the country if reports are to be believed. A Boston banking house stands ready to convert the whole issue of bonds for the railway into money.

Winnipeg, Man.—A new electric light company is being organized in the town of St. Boniface. By its charter the company expects to obtain the liberty of operating in any part of the province of Manitoba, including the city of Winnipeg.

New Haven, Conn.—The New Haven Street Railway Company has purchased the Edgewood Avenue Electric Road and taken control. Handsome parlor trolley cars are to be added to the company's rolling stock for the accommodation of "trolley parties."

Springfield, Mass.—A new electrical company has been organized in this city to be known as the Springfield Electric Equipment Company; it will deal particularly in general electrical supplies. The managers of it are W. F. Evans and H. W. Wright, both of Springfield.

Baton Rouge, La.—The electric plant and the rolling stock and franchise of the Capital City Railway and Lighting Company are advertised for sale in execution of judgment obtained by the Bank of Baton Rouge, the holder of about $40,000 of mortgage notes.

Baltimore, Md.—Subscriptions to the capital stock of the Baltimore, Severn Park and Annapolis Electric Railway—$250,000—are to be opened at the offices of G. Howard White in this city. The plans are for a road twenty-eight miles long, of single track construction, and a power house at Severn Park.

Allegheny, Pa.—The select council has passed the ordinance giving the electric light apparatus contract to the Westinghouse Electric Company. It now goes to the mayor. It is understood that the Western Electric Company, whose bid was lower than that of the Westinghouse Company, will take the matter to the courts.

Portland, Me.—The Legislature will be asked this winter to charter an electric railroad to run from some point in the city of Portland along the Cape shore for fifteen miles in a southerly and southwesterly direction. The petitioners are F. Coleman Boyd, of New Haven, Conn., J. S. Winslow, J. H. Boyd and A. R. Boyd.

New York.—Prof. L. I. Blake, who is now at work perfecting his apparatus for telephoning at sea, writes to a friend that the experiments made lately between the lighthouses and the shore have been highly successful and demonstrate that his invention for communicating between vessels at sea or between sea and land is practicable.

Detroit, Mich.—The new Detroit Railway Company has accepted the franchise granted by council, and given the required bonds. The following have been elected officers of the company: President, Green Pack; secretary treasurer, Albert Pack; vice-president and general manager, Henry A. Everett; assistant secretary, S. R. Break.

Richmond, Va.—The common council at its meeting on the 8th inst., adopted an ordinance revoking the franchise of the Southern Bell Telephone Company. A petition was presented at the same meeting from Samuel Regester and associates asking for the right to establish a telephone exchange and guaranteeing as good service as the Bell Company at about half the rates.

Rochester, N. Y.—In view of the opposition which seems to have developed within the last few weeks in Buffalo to the introduction of electric power from the great plant of the Niagara Power Company, it is understood that a vigorous movement is on foot in Lockport, Rochester and Syracuse to induce the Niagara Power Company to build its first transmission lines to these cities.

Williamsport, Pa.—A company has been formed here for the purpose of supplying electric light and power in the central part of the city. The new company will be known as the Citizens' Electric Company, with Grant Sweet president and C. Harvey Hill, late foreman of construction for the Lycoming Electric Company, as general manager. The plant will be equipped with the most approved machinery.

Fort Lee, N. J.—This village is to be the principal place of business of the Bergen County Traction Company which, according to its specified route, will cover the most desirable portion of the eastern side of Bergen County. The capital is $500,000, and the incorporators are Leon Abbett, Jr., of Hoboken; John Aird Dempsey, of New York; William H. Clark and Charles W. Colladay, of Philadelphia. The route will traverse a distance of thirty-five miles.

Central City, W. Va.—It is reported that a company is being formed by prominent individuals to secure a right of way for an electric street railway between this city and Catlettsburg, Ky. This line, when completed, will form the connecting line for a street railway from Ironton, O., to Guyan River, a distance of twenty-three miles, connecting the cities of Guyandotte, Huntington and Central City, W. Va., Catlettsburg and Ashland, Ky., and Ironton, O.

Alexandria, Ind.—The city council has granted to Joseph E. Jeffries a franchise for the construction of six miles of electric street railway within the city limits. Jeffries at once filed with the clerk his acceptance and bond of $5,000, with Congressman Henry, of Anderson, as surety. By the terms of the ordinance the Indianapolis, Anderson, Alexandria and Marion Electric Street Railway Company will be unable to gain an entrance into the city except over the tracks of the Jeffries company.

Philadelphia.—The Department of Public Safety advertises for proposals for furnishing supplies to its several bureaus during the year 1895. Among the things desired are telephone stations, telephones and transmitters, mast arms, iron posts, iron and copper wire, battery supplies, cables, poles and cross arms; also general electrical supplies, electric arc lights, etc. Proposals may be addressed to Abraham M. Beltler, director of the Department of Public Safety, until Dec. 21 at 11 o'clock A. M.

Warren, Ohio.—The electric railway controversy, involving three companies, which were each seeking to get a franchise between Niles and Youngstown, by way of Girard, has been decided by the county commissioners. The Mahoning Valley Company was given the franchise, with the condition that it must have the road in operation within nine months. The Mahoning Valley Company was but recently organized by Cleveland, Youngstown, Warren and Niles men, and is capitalized at $150,000.

West Chester, Pa.—The *Republican* gives some space in its issues to local electric railway affairs under the heading of "Trolley Tips." One of the items in a late number reads as follows: "Conductor Lewis Gunkel, of the Market street line, is growing a new set of whiskers and when they attain a respectable length the conductor will whistle at the wintry winds, which will undoubtedly be unable to affect (?) an entrance through the conductor's beard, if the present infant growth is an indication of what is to come."

Carthage, Mo.—The trustee's sale of the Joplin Electric Railway was made on the 11th inst., by Judge George A. Madill, of St. Louis, representing the Union Trust Company. The road was bonded for $150,000, and was bought by Dr. Powell, of St. Louis, for the Carthage, Webb City, Joplin and Galena Electric Railway Company, for $35,000. It is expected that at an early date the road will be extended from Joplin to Galena, and then be connected with the road now being planned from Carthage to Carterville.

Dayton, O.—The contract for the construction of the electric plant at the Southern Ohio Hospital for the Insane has been let to the Western Electric Company of Chicago.—The Dayton electric light plant, owned by the General Electric Light Company of Boston, has been bought by a syndicate of Dayton men. The plant is valued at $600,000. The Dayton syndicate is headed by J. E. Lowes, R. N. King and Charles Reber, all prominent capitalists here. The Dayton men formerly owned considerable stock in the General Electric Company, but all has been converted into Dayton electric stock.

Lockport, N. Y.—The ninety days that the common council gave the Bell Telephone Company in which to enter into a contract with the city, meaning that it should reduce its rates for dwellings to $2 a month and business houses $2.50, or remove its wires and poles from the streets, having expired without the company showing any inclination to do one or the other, the council has adopted a resolution directing the superintendent of streets to notify the Bell Telephone Company to remove their property from the streets forthwith.

Sacramento, Cal.—The General Electric Company has recently entered into a contract with the Folsom Water Power Company to supply dynamos, generators, transformers, poles, wires, etc., in fact the entire plant necessary to generate the electric current at Folsom, transmit it to Sacramento, and transform it to the potentiality necessary for light and power at this point, the time fixed in the contract for the completion of the work being six months. The dam and canal are already completed and work on the power house is being rapidly pushed.—The South Yuba Water Company will, it is stated, apply to the Sacramento City trustees for a franchise to permit them to bring into Sacramento an electric wire line for transmission of power from Newcastle or some point in that neighborhood.

Augusta, Me.—A scheme is being evolved for the construction of an electric railroad between this city and Waterville. It is proposed to lay a broad gauge track of heavy rails over a graded roadbed from Waterville to East Vassalboro; thence to Getchell's Corner, Vassalboro; thence down the river to Augusta. Over this line cars will be run hourly, impelled by powerful motors at a rapid rate. The distance between the two cities direct is eighteen miles, and by the new line of the road via East Vassalboro it is only twenty miles, or two miles further. As a portion of the scheme a big summer hotel will be erected at Bradley's, East Vassalboro. It is proposed to make the trip between Augusta and Waterville in just an hour. From East Vassalboro a branch will be extended to Weeks Mill to connect with the Wiscasset narrow gauge. This will also be laid standard gauge with trolley equipment, and a 120 H. P. motor is to be run, which will be able to haul sixteen loaded freight cars from the mills to Waterville. Furthermore, a third rail will be laid between Waterville and the mills, so that the narrow gauge cars of the Wiscasset road can be hauled over the road. From Waterville the system is to be extended to Fairfield over the rails of the Waterville and Fairfield Electric Road, the third rail being added, and thence, it is the intention to carry the extension to Shawmut. Both water and steam powers are to be employed for the electric service.

COMMERCIAL PARAGRAPHS.

The Metropolitan Electric Company of Chicago have taken the General Western Agency for the Large & Twining station and line Switches and are getting in a large stock of all sizes.

The Drawbaugh Telephone and Telegraph Company, 25 Broadway, New York, is prepared to sell and lease Telephones and to construct complete Telephone Central Office Exchanges and long distance Telephone Systems, under the inventions and patents of Daniel Drawbaugh, the original inventor of the telephone.

The Central Electric Company, Chicago, always up to date in catalogue and advertising matter, have issued an important supplement to their last general Catalogue.

The Mather Electric Company of Manchester, Conn have just been awarded, through their New York contractors, Messrs. H. B. Coho & Co., the contract for three 10 K. W. direct connected Generators of their new type, for the lighting plant of the new Congressional Library Building at Washington, D. C.

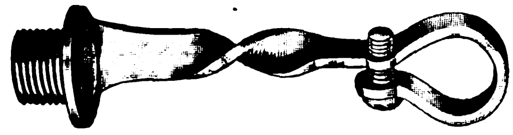
The La Roche Electrical Works.

Mr. A. La Roche, President and General Manager of the La Roche Electrical Works, reports the following sales of their well-known apparatus: Wernersville Insane Asylum, South Mountain, Pa., three 1,000 light bipolar dynamos; Burtis & Howard, Minneapolis, Minn., one 800 light alternator; Jefferson Ice Company, Philadelphia, one 200 light dynamo; Lorraine Apartment House, Philadelphia, two 1,200 light and one 600 light dynamo; Atchison Light and Power Company, Atchison, Kansas, one 800 light and one 1,500 light alternator; McCurdy Bros., Philadelphia, one 80 K. W. direct current dynamo, Dedham Court House, Dedham, Mass.; one 20 K. W. alternating dynamo; Hammond Light and Power Company, Hammond, Ind., one 3,000 light two-phase alternating current dynamo and accessories, duplicate order; Berkeley Electric Light and Power Company, Berkeley, Cal., one 1,500 light alternator, duplicate order; Atchison Light and Power Company, Atchison, Kansas, transformer; capacity for 5,000 lights; Wm. Hood, Chicago, Ill., one 3,000 light alternator, one 500 light alternator and one 1,500 light alternator.

The management state that they are running with a full force of men; and in order to make prompt deliveries are compelled to run the works several evenings each week.

Universal Fixture Attachment.

The Independent Electric Company of Chicago are placing on the market a new lamp fixture attachment, which we illustrate herewith. This article seems to have several specially good points and is known by the name of "Universal." It can be readily and permanently attached to gas fixtures without breaking the gas joint, which is a very desirable feature. It is also very flexible and at the same time strong. Having no soldered joints, there is no danger to the lamp even if fitted with a heavy shade. The appearance of this attachment is also in its favor, and we have no doubt that it will meet with good success.



The above company make a full line of this class of goods, including socket hooks both single and double, such as illustrated herewith.

Interior Conduit Company in Buffalo.

The American Electric Supply Company of Buffalo, N. Y., have severed their agency relations with the Interior Conduit and Insulation Company of New York. The American Electric Supply Company is one of the oldest agents of the Conduit Company, and the relations between the two companies have always been of the pleasantest character. The Conduit Company, however, have found that their interests are antagonized when represented by a construction house, and have consequently changed their policy and in the future will be represented by supply houses not engaged or financially interested in the construction business. The American Electric Supply Company could not afford to give up the large construction business they enjoy, and hence followed a friendly termination of their agency relations with the Interior Conduit and Insulation Company.

A New Toy Motor.

M. R. Rodrigues, of 17 and 19 Whipple street, Brooklyn, N.Y., who has done so much in the way of electrical toys, has gotten out a new toy electric motor to be operated by a single cell of any good battery. It is an exceedingly compact and simple little device, which will prove an inexpensive and very acceptable addition to Santa Claus' outfit. Presents of this kind have a value far in excess of that of mere toys. They have an educational value of a high order, and might be used to advantage in the school room as well as in the nursery.

E. E. & S. Company.

The Electric Engineering and Supply Company of Syracuse send out a handsome new catalogue of their well-known lighting and railway supplies. The line is complete and of the highest standard. The catalogue will be sent on application. The New York office of the company is at 136 Liberty street.

INCORPORATIONS.

The New Jersey and Delaware Electric Forging Company, Newark, N. J.—to rent, furnish and lease apparatus for forging, welding, heating, etc., iron, steel, copper or other metals through the medium of electricity in a liquid solution, etc. Capital stock, $250,000. Promoters: Fred'k A. Nichols, Arlington, N. J.; Barnard J. Fredericks, New York City; Edw. Kenny, Newark.

The Ferris Electric and Manufacturing Company, Cedar Rapids, Iowa—to make, buy, sell, lease and repair electrical apparatus or appliances; equip and operate the same. Capital stock, $10,000. Promoters: W. J. F. Ferris, Chicago, Ill.; Thos. Ferris, Robert Ferris, Cedar Rapids.

The Denison Electric Light and Power Company, Denison, Iowa—to establish and maintain an electric light and power plant at Denison. Capital stock, $20,000. Promoters: J. B. Romans, E. Culick, J. N. Bradley, Denison.

The Sidney Electric Railway Company, Sidney, Ohio—to construct and operate a railway by electric or other motive power in Sidney, thence to Loramies and Minster, Ohio. Capital stock, $100,000. Promoters: Chas. Timeus, Jno. Loighlin, I. H. Thedieck, Wm. Piper, Jno. H. Wagner.

People's Electric Railway Company, Terre Haute, Ind.—to construct and operate electric railway. Capital stock, $100,000. Promoters: Andrew I. Crawford, Jas. P. Crawford, Geo. J. Hammerstein, Edwin Ellis, Herman Hulman, Sr.

The New Mexico Electro-Chemical Reduction Company, Chicago, Ill.—to mine, reduce, refine and treat ores, minerals bearing gold, silver or other precious metals. Capital stock, $100,000. Promoters: Otto R. Barnett, Glenn C. Plumb, Clark Edw. Ridpath.

The Mexican Electro-Chemical Reduction Company, Chicago, Ill.—to mine, reduce, refine and treat ores, minerals bearing gold, silver or other precious metals. Capital stock, $100,000. Promoters: Otto R. Barnett, Glenn C. Plumb, Clark Edw. Ridpath.

The Niagara Engineering Company, Model City, N. Y.—to build and equip electric light, railway, heat and power plants, and make and sell the necessary apparatus. Capital stock, $10,000. Promoters: L. B. Dorr, C. C. W. Nobles, L. E. Squier, of Buffalo, N. Y.

The Chatham Electric Light and Power Company, Savannah, Ga.—to operate an electric light and power plant. Capital stock, $35,000. Promoters: Geo. Parsons, Henry Parsons, Jas. J. Johnston, John N. Harriman.

The Paducah Electric Company, Paducah, Ky.—to furnish arc and incandescent electric light, power for motors, elevators, etc. Capital stock, $40,000. Promoters: Elbridge Palmer, R. Rowland, J. L. Friedman, J. W. Keller, W. A. Gardener, F M. Fisher, A. E. Einstein.

The Niagara Engineering Company—to construct electric light, railway, heat and power plants, and to manufacture machinery to equip the same in the United States and Canada. Capital stock, $10,000. Directors: L. Bradley Dorr, of Clifton, and C. W. Nobles and Leon Esquier, of Buffalo, N. Y.

The Staten Island Electric Railroad Company—to construct a steel surface road about twenty-two miles in length in and between New Brighton and Edgewater, and the towns of Northfield and Southfield, Richmond County, N. Y. Capital stock, $1,250,000. Directors: George B. H. Harvey, Milton L. Bouden, John A. Hilton, John J. Walsh, Wm. H. Hurst, John T. Mills, Eugene R. Leland, A. J. Hummell and Henry Haggerty, of New York City.

The Fulton Valley Telephone Company—to connect Middleburgh with Fulton, Fultonham, Breakabean and Blenheim, all in Schoharie County, N. Y., by telephone. Capital, $500. Directors: Albert L. Rosekrans, Chas. W. Vrooman, Chas. Bouck, of Fulton, and others.

Woven Wire Brushes.

The Belknap Motor Company of Portland, Me., are the patentees and manufacturers of the best Woven Wire Brush on the market.—[*Adv.*

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED DECEMBER 11, 1894.

ELECTRIC RAILROADS AND APPLIANCES.

530,507. Controller for Electric Locomotives. John W. Darley, Jr., Baltimore, Md., assignor to the General Electric Company, Boston, Mass. Filed Nov. 16, 1893.

530,543. Conduit Electric Railway. David Mason, Schenectady, N. Y. Filed June 8, 1893.

530,569. Trolley-Wire Clamp. Montraville M. Wood, Chicago, Ill., assignor to The Ohio Brass Company, Mansfield, Ohio. Filed July 2, 1894.

530,661. Switch for Overhead-Trolley Tracks. Charles G. Schmidt, Cincinnati, Ohio. Filed Aug. 13, 1894.

530,674. Trolley-Wire and Support Therefor. Herbert H. Ashley, Springfield, Mass. Filed Aug. 25, 1894.

530,688. Conduit-Railway Trolley. Joseph C. Hawley and William J. Black, Duncannon, Pa. Filed March 22, 1894.

530,828. Conduit-Railway Trolley. Walter E. Delabarre, Francis M. Frazer and Robert A. Carrick, New York, N. Y. Filed Jan. 26, 1894.

ELECTRIC LIGHTS AND APPLIANCES.

530,751. Shade-Holder for Incandescent Electric Lamps. Nathan W. Crandall and Edgar A. Russell, Wallingford, Conn., assignors to the Housatonic Manufacturing Company, same place. Filed June 18, 1894.

530,838. Incandescent Lamp. Jacob R. Grove, New York, N. Y., assignor to Walter E. Peck, trustee, same place. Filed May 26, 1893. Renewed May 14, 1894.

530,895. Incandescent Electric Lamp. Edward Kaye, Monaca, Pa. Filed Feb. 4, 1893. Renewed Nov. 10, 1894.

DYNAMOS, MOTORS, ETC.

530,516. Suppression of Self-Inductive Obstruction in Electro-Magnetic Apparatus. Stephen D. Field, Stockbridge, assignor to the American Bell Telephone Company, Boston, Mass. Filed July 24, 1894.

530,597. Alternating-Current Transformer. Alexander W. Meston, St. Louis, Mo., assignor to the Emerson Electric Manufacturing Company, same place. Filed Jan. 23, 1893.

530,619. Electric-Motor-Propelled Elevator. Frank E. Herdman, Indianapolis, Ind. Filed Jan. 31, 1893.

530,717. Brush for Dynamo-Electric Machines. Edward T. Platt, Chicago, Ill., assignor of two-thirds to William Freise and Charles O. Moyer, same place. Filed June 11, 1894.

530,748. System of Transmitting and Distributing Electrical Energy. Cummings C. Chesney, Pittsfield, Mass., assignor to the Stanley Laboratory Company, same place. Filed April 19, 1894.

530,773. Electric Motor. Frank E. Herdman, Winnetka, Ill. Filed July 25, 1894.

BATTERIES.

530,764. Primary Battery. George H. Gardner, Boston, Mass. Filed March 12, 1894.

530,804. Battery-Switch. Heinrich K. Spangenberg, Leipsic, Germany. Filed July 24, 1893.

530,847. Process of Manufacturing Plates for Secondary Batteries. Hugh F. Kirkpatrick-Picard and Henry Thame, London, England. Filed Jan. 13, 1894.

530,867. Primary Battery. William Walker, Jr., Birmingham, and Frank R. Wilkins, Handsworth, assignors of one-third to Jabez Lones, Smetwick, England. Filed June 4, 1894.

TELEPHONE AND TELEGRAPH APPARATUS.

530,575. Telephone-Transmitter. Arthur F. Boardman, Somerville, assignor of one-half to James D. Leatherbee, Braintree, Mass. Filed Aug. 6, 1894.

530,598. Telephone System. Wilhelm Oesterreich, Berlin, Germany. Filed Oct. 12, 1893.

SIGNALS AND SIGNALING APPARATUS.

530,762. Electrical Block-Signal Apparatus. Urias J. Fry, Milwaukee, Wis., and George M. Basford, Oak Park, Ill. Filed July 5, 1893.

560,763. Block-Signal Apparatus. Urias J. Fry, Milwaukee, Wis., and George M. Basford, Oak Park, Ill. Filed Sept. 17, 1894.

530,798. Railway-Signal. James V. Richardson, Farmville, Va. Filed March 30, 1894.

MISCELLANEOUS.

530,498. Insulator for Electric Overhead Construction Henry P. Ball, Bridgeport, Conn., assignor to the General Electric Company, Boston, Mass. Filed June 28. 1894.

530,517. Process of Manufacturing Insulating Compositions for Electrical Purposes. Alfred N. Ford, London, England. Filed June 11, 1894.

530,522. Galvanic Ring. David Hattenback, Sioux City, Iowa. Filed Sept. 4, 1894.

530,541. Apparatus for Electric Controlling Elevators. Nils O. Lindstrom, Union Course, and Orrie P. Cummings, Brooklyn, assignors to the A. B. See Manufacturing Company, Brooklyn, N. Y. Filed Sept. 20, 1894.

530,578. Electric Elevator-Controller. Leroy S. Buffington, Minneapolis, Minn., and Walter C. Jones, Chicago, Ill. Filed Feb. 23, 1894.

530,592. Magnetic Water-Gage. Ljubomir Kleritj, Belgrade, Servia. Filed March 27, 1893.

530,637. Electric Cigar-Lighter. Clyde J. Coleman, Ill., assignor of one-half to Robert Burns, same place. Filed March 24, 1894.

530,648. Fire-Alarm and Annunciator System. Frederick S. Palmer, Boston, Mass. Filed March 24, 1894.

530,706. Insulator. Louis McCarthy, Boston, Mass. Filed Sept. 18, 1894.

530,727. Rheostat. Thomas W. Shelton, St. Louis, Mo. Filed Aug. 20, 1894.

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N. E. L. A.—The next annual meeting of the National Electric Light Association will be held at Cleveland, O., February 19-21, 1895. Every concern interested in either lighting or railway work should be represented in the membership of this body, and should have at least one representative at the Cleveland meeting. The Secretary is Mr. Geo. F. Porter, 136 Liberty street, New York.

EDITORIAL NOTES.

Electrical Storage. We conclude this week the very interesting article by Mr. Alfred H. Gibbings on "The Commercial Possibilities of Accumulators for Tramcar Traction." In this chapter the author enumerates more particularly the advantages of electrical storage, and further emphasizes the possibilities resulting from a union of diverse interests. Many of the arguments he makes use of could apply with almost equal force to a union of private interests also, and it is their application in this way that will most interest us on this side of the Atlantic. Nearly a year ago Mr. Erastus Wiman pointed out the same thing in a forcible article contributed to the *Engineering Magazine*. His own interests had led him to consider the feasibility of combining suburban land, electric lighting and electric railway interests, and his studies brought him to the conclusion that, where practicable, those interests would severally be very much benefited by joining forces. He did not consider the question of storage, however, and that is really the vital point at issue with every electrical man in the country, whether he knows it now or not. There are, indeed, probably few who as yet realize what wealth of meaning that term "storage of energy" has when rightly understood. Our English brethren are more fully alive to it than we, but the time is not far distant when we as they will define it each for himself. It means no less than a saving of 50 per cent. in the cost of our energy, and this means far more than getting our coal at half price.

The author presents the advantages that electrical storage offers in light and power stations as they occur to him. While we think that some of his points are not entirely well taken, they are in the main correct. He has, however, omitted one advantage of electrical over other methods of storage that we think gives it the preference where the ultimate product is electricity, and that is, that the storage occurs much later in the cycle of changes and transformations, thus contributing to the economical working of a larger proportion of the plant than is possible where the storage takes place earlier, for it will be understood that only those operations which precede the storage proper can receive any direct benefit thereby. And thus it is that in electric light stations, where the storage is the last step previous to distribution, the whole plant, dynamos, engines and boilers, is benefited to such an extent as to make even the high initial cost of installation of the storage battery plant a matter of ultimate economy.

We expect to see during the coming year a great awakening among the electrical community to the importance of storage of energy in some form. What this form will be remains to be seen, for it will work its way out. In the meantime it will be our province to keep our constituents advised of all important steps looking to an amelioration of our present wasteful and unfortunate methods.

* * *

A Gassy Theory. Our esteemed and well-edited contemporary, the *American Gaslight Journal*, knows a great deal about gas, but evidently mighty little about electrical matters. In a recent issue there is the following gassy information:

> "We do not propose to enter into any controversy with ELECTRICITY over the merits of Doctor Auer's burner, but we are more than pleased to say that the Auer burner of 1894 is as vastly superior to the burner of 1886 as the 15-candle power incandescent electric lamp of 1894 is inferior to its prototype of 1886. In other words, the Auer burner has advanced, while the Edison burner lamp has retrograded. The electricians have seemingly learned what the generating of steam power for the actuation of dynamos means, and the gas men are more than awakening to the possibilities of their product, which stands as the representation of the development of energy only once removed."

The Auer burner may have been improved in eight years; we suppose it has been. If it is to come into general use it might need eight more years of improvement.

But to talk of a retrograde movement in the incandescent lamp field is the veriest nonsense, and if our contemporary had been up to date, burning the lamp in its own offices all these years, it would have known more about the subject.

The incandescent lamp of to-day is of double the life and double the efficiency of eight years ago, while the price is just one quarter what it was then. The bamboo filament has been discarded by every maker save the Edison people, Weston's hydrocarbon treatment patent has been thrown open to the world, there has been a marked improvement in glass blowing, in the manufacture of the necessary pumps; there has in fact been a radical improvement in every detail.

But the gas to-day seems very much like the gas of our childhood; there is the same volume of heat in a five-foot burner, the same smoke, the same unhealthy fumes polluting the atmosphere, the same old meter measuring 1,000 feet for every 500 feet consumed.

Get thee to a lamp factory and learn wisdom!

* * *

Is Electricity Raising up Competitors? Scarcely a month passes without the announcement of some new chemical reaction which has been rendered commercially possible only by means of electrical agencies. At first electricity's most potent influence seemed to be in the rôle of an iconoclast—tearing to pieces chemical structures and giving us in cheaper if not commercial form many of the metals which had previously been known chiefly as curiosities. One by one all of the refractory ores of the rarer elements have succumbed to the subtile fluid and yielded up to art their hidden treasures. Thus we have now aluminum, nearly as cheap as copper, manganese, boron, silicon, etc., etc., as articles of commerce, either pure or as important constituents of alloys, and so on as far as the properties of the elements have created a demand for them in the useful arts. But perhaps electricity's greater power for good will be demonstrated in its enabling us to build up new compounds from their elements or from simpler combinations. In fact its utility in synthetical chemistry is already becoming clearly apparent to such a degree as to give bright promise for the future.

One of its recent applications to synthesis is very fully dealt with by Dr. Wyatt in an article written especially for the *Engineering and Mining Journal*, on "Calcium Carbide and Acetylene," which we reproduce in this issue. The cheap production of calcium carbide, from which acetylene gas may be produced by the simple addition of water, points to one of the most interesting possibilities in the line of original research imaginable. May it not forecast the ideal storage of energy? In this case, neither calcium carbide nor water is a fuel, but together they give rise to a fuel capable of giving out when burned the enormous quantity of 61,000 heat units. Acetylene is known as giving the most highly luminous flame of any of the hydrocarbon gases, and for this reason, together with the facility with which it may be produced by the simple addition of carbide of calcium to water, seems likely to bring it soon into competition as an illuminant with electricity. It has several disadvantages, however, which will go far to offset its advantages over ordinary illuminating gas. The first is that it burns ordinarily with a very smoky flame. Means must be devised to overcome this before it can be used successfully as an illuminant. In the second place, the gas unites directly with copper, forming a highly explosive compound, and therefore copper or brass must be eliminated from the fixtures in which it is to be used.

Its odor, too, is extremely offensive—it is that which we smell when an oil lamp is turned low. This smell, however, is rather an advantage, in that it gives timely warning of the existence of leaks. The carbonic oxide, of which we have spoken in connection with the Welsbach light, on the other hand gives no warning whatever, so that we see that in this very odor lies its comparative safety.

But with its high calorific power comes its extreme adaptability to gas engine use, and it seems exceedingly probable that if the gas can be manufactured cheaply enough to compete with coal gas it will place in the hands of the electric light manufacturer an equally cheap and efficient fuel for his gas engine, by which the electric light can be manufactured as much cheaper than acetylene gas light by means of acetylene as it can now be manufactured cheaper than coal gas light by means of coal gas, through the intermediary of the gas engine.

* * *

Practical Educational Work. ELECTRICITY has already expressed hearty commendation of the scheme of the Brooklyn Electrical Society, which is holding weekly meetings for the winter in the parlors of the Brooklyn Edison Company. It is our opinion that classes of this nature can accomplish more in the dissemination of popular knowledge in the elements of electrics than would be possible in connection with any of the correspondence schools or with the National School of Electricity or any similar scheme. The cost per capita, moreover, is insignificant; the commercial future is eliminated.

Prof. Wm. D. Marks has arranged a somewhat similar plan in Philadelphia, where the meetings are being held in the Edison Company's offices.

The advantages of this plan over the school we have criticised so severely are manifest, and there ought to be no trouble, in any community where thirty or forty young men want to get together for study of the subject, to arrange with the local central station people for a meeting place and for the use of apparatus.

There is in this plan no sailing under false colors, no misrepresentation, no "honorary faculty," no distribution of stock for the use of names, and those who pay have the satisfaction of knowing where their money goes.

Under the Searchlight.

Views and Opinions on Timely Topics.

A Searcher After Truth.

(From the Sunday School Times.)

Few finer things could be said of any discoverer than what has been said of the late eminent physicist Helmholtz: "He never indulged in one of those reclamations of priority into which scientific vanity is sure to be betrayed, but several times published notes to show that his results were not so new as he and the scientific world had believed them to be." When the world is doing homage to one whom it acknowledges as its great master in science, what grim delight must he find in reminding his admirers that the truth is first, even though it compel them to regard him as second!

American inventors and scientists have rarely exhibited any such trait as is here ascribed to Helmholtz. If they had done so, history would have given them a higher place in the records of their time, although perhaps they could have made less money. We say "perhaps," because it is not certain but that they would have made more money.

Take the incandescent lamp matter for an example.

History must record that the incandescent lamp was not the invention of any one man; that it was in fact not an invention, but a gradual growth to which the brains of a dozen or a score of men contributed. Yet for fifteen years there has been a succession of disgraceful legal fights to establish priority—not for the sake of honor, but for gain. Millions of money have been wasted, and the world does not know to-day to whom belongs the credit.

* * *

What They Say of Us.

"ELECTRICITY is full of surprising antics and fancies."—*Chicago Post.*

Not Only of the South—Of the Entire Country.

(From the Richmond State.)

ELECTRICITY is doing much to build up the industries of the South.

It is pleasant to know that our intelligent efforts are at least partially appreciated.

THE DINAMONEER.*

'Tis of a German scientist, Von Splutterdutch, I sing;
He laughed at the impossible—went in for everything;
Concocted mild explosives, a *soupson* of whose scent
Would pulverize the universe and rend the firmament.

But most he wished to flatten out the mystery of man,
And blood-and-bone magnetics were the pivot of his plan.
So here he brought the Leyden-pots he'd shocked them with at home,
For Vaterland (that knew him well) had ordered him to roam.

He took a flat at Kensington, recked nothing of the price;
Could he attract his species he'd be wealthy in a trice.
The topmost floor his laboratoire—thence could he range afar—
Negotiate the thunder-cloud and tap the polar star.

But Splutterdutch worked overmuch and felt his spirits flag,
So drank a pail of potent ale and smoked a pound of shag,
Then dozed, and dreamt of fortune won, of nations all intent
To "elevate the masses" with his wondrous instrument.

He dozed—verblast! he nodded—strumm! his noddle fetched a blow
On the "pressel, knob or button" that connected up the show.
Splitz! Fitzel!! und ge-blazes!!! the angry currents flash
And hurl him on the Magnet with a dynamitic crash.

A dinner party down below was lifted into space
Without one ounce of unction, nay, without one hint of "grace."
Herr Splutterdutch's first essay had justified his views,
For it glued them to the ceiling—and that's the latest news.

---

* From "Lika Joko."

THE NATIONAL SCHOOL.

The Faculty is Purely Honorary.

Prof. Thomas Corrects Us.

To the Editor of ELECTRICITY.

In your issue of November 28, Prof. Fessenden says : " I might add that, in a recent letter to a mutual friend, Prof. Thomas has stated that he has ceased to be actively connected with the School," meaning the National School of Electricity. The statement is untrue—that is, the statement which I am said to have made to a mutual friend was not made.

Before making this denial, I wrote to Prof. Fessenden asking him to name the mutual friend and to quote the sentence from the letter referred to. He named the friend and quoted the following sentence as referred to : " My connection with this School is advisory only," which is correct.

This disposes also of your unwarranted editorial assertion that my position is stated by Prof. Fessenden. Yours truly,

BENJ. F. THOMAS.

Ohio State University, Columbus, O., Dec. 15.

We are unable to see in what respect we have done Prof. Thomas an injustice.

Prof. Fessenden said " he had been advised that . . . Prof. Thomas . . . has ceased to be actively connected with the School."

Prof. Thomas had said : " My connection with this School is advisory only."

We fail to see any material distinction, except that the first implies that at some time Prof. Thomas had been actively connected with the School, performing the duties which the young men who pay the tuition fee suppose he is now performing for their benefit.

In this much we offer Prof. Thomas an apology for creating a wrong impression.

We contend that so far every expression of fact made public from the honorable gentlemen composing this faculty merely clinches our argument that the School is being conducted on a dishonorable basis. It is sailing under false colors, misrepresenting the position of the faculty. It has, moreover, grossly exaggerated the possibilities of benefit to be derived from the course even if every member of the faculty were doing the full duty which the School represents him to be doing.

We have authentic information that three men of national reputation were each offered $1,000 stock in the School in consideration of the use of their names as members of the faculty. They declined the stock and refused the use of their names.

We know of one member of the faculty who returned the stock when it was sent to him, and who has since demanded that the use of his name be discontinued, for the reason that his name was not being used according to the terms of the original agreement. This agreement was that the School was to use his name *only* as member of an honorary and advisory faculty. His name has not yet been removed from the stationary and advertising matter, but no doubt will be.

We mention this matter to show that *some* of the gentlemen whose names have been wrongly used have a sense of propriety very like ordinary business men.

Our columns are open for any statement from any member of the faculty in regard to this matter of the payment of stock, and we shall soon publish the actual facts which are attainable.

To revert to the fundamental plan of the School : What precedent is there for an honorary or advisory faculty in an educational institution ?

What do the students buy with their money if not the benefit of the knowledge and instruction of the members of the faculty ?

So far as we know, Prof. Dugald C. Jackson and Prof. Henry S. Carhart are the only two members of this faculty who have performed the duties which the students suppose they have performed.

If there are others we shall be glad to add their names to the list.

Decency and honor demand that all other names be eliminated from the faculty at once.

BOOK REVIEW.

ON THE DEVELOPMENT AND TRANSMISSION OF POWER FROM CENTRAL STATIONS. By WILLIAM CAWTHORNE UNWIN, F.R.S. Cloth, 8vo. 308 pp. London and New York: Longmans, Green & Co.

This book is an elaboration of the course of Howard lectures delivered at the Society of Arts in 1893 by Prof. Unwin, and is a very successful attempt to present in concise and rather popular form the subject of transmission of power as a whole. This involves a discussion of the causes of waste in generating power as well as the losses in distribution, which are factors of such great moment at the present day. Probably no one is more competent to deal with this subject than the author, nor would any name carry more weight with the opinions expressed than that which is appended here. In dealing with such a broad subject it is not to be expected that any department should be as fully treated as a specialist in that department would desire, but the book is specially designed *not* for the specialist, but for that large class of readers, the *users* of power, who are not technicians but business men who wish to be informed as to the business end of power development and transmission. For these, we know of no book that so fully meets the demand as the one under review.

In the opening chapter the author discusses the conditions in which a system of distribution of energy is required and general considerations on the sources of energy. He guards strongly against the impression that with modern electrical methods anything has been added to our knowledge of the production of energy in an available form, for he says : " We are just where we were before modern electrical discoveries were made. The most the electrician can do is to provide a new mechanism of distribution." He then goes on to show that although this new mechanism may have special advantages where power is to be conveyed long distances, the cases where even electrical means are advisable from the commercial standpoint are rare, and cites the remarkable mechanical and scientific success of the Frankfort-Lauffen experiment, in which 300 H. P. was conveyed 108 miles with a loss in transmission of but 25 per cent., as an instance of commercial unsuccess. The reason was that when the power was delivered at Frankfort it cost five times as much as it could be produced there for by a steam engine.

In speaking of the various kinds of fuel, he includes town refuse, to which he assigns a fuel value of about one-fifth that of coal, and then follows a description of a number of types of furnaces adapted to the combustion of low grade fuels of which town refuse is a type.

Chapter II treats chiefly of the conditions of economy and waste in power generated by steam engines. Numerous tables of boiler and engine efficiencies are here given for reference. Engines in electric light stations receive especial attention because of the extreme variations of load to which they are subjected. As illustrating the progressive economies effected in this kind of service, the figures of the Kensington station are quoted, which in 1886 required 12 lbs. of coal per hour per electrical unit generated, in 1890 8 lbs. of coal, and in 1892 but 7 lbs. of coal. He states that up to the present the consumption has in no case been less than 6 lbs. per unit generated ; 3.8 lbs. per effective H. P. or 3. 3 lbs. per indicated H.P. The large consumption he traces later on to the engine and boiler waste due to variation in load.

In speaking of steam turbines, he notes the production of 63.7 brake H. P., with a consumption of the remarkably low amount—2.67 lbs. coal per B.H.P. This was with the Laval turbine. It is also pointed out that these wheels will work with nearly equal efficiencies at light loads as with full load.

Chapter IV, which comprises 27 pages, covers in a very satisfactory manner the subject of Storage of Energy. This is, to our mind, by far the most important chapter in the book, for upon the successful storage of energy depends the solution of the greatest problem now before the electrical engineering profession, viz., how to equalize the load line of our electric light and power stations. Prof. Geo. Forbes has stated that the cost of fuel in a well conducted central station due to the variable load is fully 43 per cent greater than it would be were the load constant, and that this loss may easily amount to $50,000 a year in a station of no extraordinary size.

The methods of storage discussed are gas, water, compressed air, electrical and thermal storage, the relative costs and efficiencies being given. Of these Halpin's method of thermal storage is given the preference. In this connection it is to be regretted that the author was not enabled to describe Mr. Halpin's later development of his system, which has occurred, however, since the date of the lectures.

Considerable space is devoted to the economies of gas engines, which, on account of their great thermal efficiencies, are great even in small sizes. The author shows that even at the figures given of gas consumption per horsepower hour a small gas engine is only equalled in ultimate efficiency by the largest compound condensing engines of the most approved type. So much improvement has been made in the efficiency of internally fired engines during the short space of time since these lectures were delivered that what is given here is by no means up to date but the present attainments only go to emphasize what is here given.

Under the head of Distribution of Power by Transmission of Gas, a good deal that is said is very old and only partially true now. This has reference chiefly to the figures given in relation to natural gas supply.

The last 45 pages are devoted to Electrical Transmission of Power and deal lightly first with its historical development, from Dr. W. Siemens's first suggestion in 1877 down to the present time. The principles involved are then discussed, and finally a number of the most noteworthy installations are briefly described—notably that at Niagara.

In conclusion, we must say that the book is by far the best that we have ever seen for the non-specialist. It will doubtless have a large sale among central station men, for while it contains much that is not, strictly speaking, electrical, there is nothing in it that an electrical man does not need to know, and there is much that will be of great interest to the very wide circle of readers which we think it deserves to have.

LONDON NOTES.

(From our London Correspondent.)

High Voltage Lamps for Central Station Use.

Mr. Edison recently pointed out that 200 volt lamps as the working minimum will largely increase the area which can be served by a low tension station. On this side of the Atlantic the great demand so far has been for 8 C. P. lamps both in groups and otherwise. Lately however there appears to be a demand springing up for 5 C. P. lamps of the same voltage, that is, 100 volts or thereabouts.

Mr. Sydney Baynes, the consulting electrical engineer to the Bradford (Eng.) Corporation, lays claim to the experiment of having first introduced high voltage lamps for central station use in England.

This gentleman has so arranged the Bradford station as to eventually run 230 volts on either side of the three wire system, or 460 volts on the two outside wires. At first he had no difficulty in obtaining these 230 volt lamps from Pope & Body (through Mr. G. Strauss, the London agent for the Venus glow lamp) and others; finally however he decided that the Venus lamp was the best, because he had run a number for 3,000 hours at 230 volts and the candle power then was 14½, with average watts per C. P. of 3.13; there were none of these broken. After so lengthy a run the lamps were only very slightly blackened and were still in good condition; a few were used by the supply customers of the Corporation, but Mr. Baynes in a communication addressed to me the other day said that " since then although orders have been outstanding by the wiring firms at Bradford and by myself, for the past four months, the lamps are not forthcoming."

Mr. Baynes now suspects that so long as there is a demand for the ordinary voltage lamp the makers do not desire to go out of their way to supply lamps at higher voltage until enterprise and opposition assert themselves. Mr. Baynes's opinion is that if a lamp maker were only enterprising enough he could secure all the trade in these lamps.

Possibly in America you, with your usual "goaheadedness," will be able to produce this lamp which European makers do not appear to care to touch. It is hardly necessary to point out that the saving in cost of distributing mains would be enormous by the adoption of the 230 volt lamp.

Bulbs of incandescent lamps are now blown with artistic designs in relief, thus obviating the use of a shade and increasing the beauty of the lamp.

Magnetic Properties of Liquid Oxygen.[*]

BY PROF. JAMES DEWAR, F. R. S.

After alluding to the generous aid which he had received both from the Royal Institution and from others in connection with his researches on the properties of liquid oxygen, and to the untiring assistance rendered him by his co-workers in the laboratory, Prof. Dewar said that on the occasion of the commemoration of the centenary of the birth of Michael Faraday he had demonstrated some of the properties of liquid oxygen. He hoped that evening to go several steps further, and to show liquid air, and to render visible some of its more extraordinary properties.

The apparatus employed consisted of the gas-engine down stairs, which was driving two compressors. The chamber containing the oxygen to be liquefied was surrounded by two circuits, one traversed by ethylene, the other by nitrous oxide. Some liquid ethylene was admitted to the chamber belonging to its circuit and there evaporated. It was then returned to the compressor as gas and liquefied, and thence again into the compressor as required. A similar cycle of operations was carried out with the nitrous oxide. There was a hundredweight of liquid ethylene prepared for the experiment. Ethylene was obtained from alcohol by the action of strong sulphuric acid. Its manufacture was exceedingly difficult, because dangerous, and as the efficiency of the process only amounted to 15 or 20 per cent. the preparation of a hundredweight of liquid was no light task. The cycle of operations, which, for want of time, was not fully explained, was the same as that commonly employed in refrigerating machinery working with ether or ammonia.

The lecturer then exhibited to the audience a pint of liquid oxygen, which by its cloudy appearance showed that it contained traces of impurity. The oxygen was filtered, and then appeared as a clear transparent liquid with a slightly blue tinge. The density of oxygen gas at —182° C. is normal and the latent heat of volatilization of the liquid is about 80 units. The capillarity of liquid oxygen at its boiling point was about one-sixth that of water. The temperature of liquid oxygen at atmospheric pressure, determined by the specific heat method, using platinum and silver, was —180° C.

Reference was then made to a remarkable experimental corroboration of the correctness for exceedingly low temperatures of Lord Kelvin and Prof. Tait's thermo-electric diagram. If the lines of copper and platinum were prolonged in the direction of negative temperature, they would intersect at —95° C. Similarly, the copper and palladium lines would cut one another at —170° C. Now, if this diagram were correct, the E. M. F. of the thermo electric junctions of these two pairs of metals should reverse at these points. A Cu—Pt junction connected to a reflecting galvanometer was then placed in oxygen vapor and cooled down. At —100° C. the spot of light stopped and reversed. A Cu—Pd junction was afterwards placed in a tube containing liquid oxygen, and a similar reversal took place at about —170° C.

Liquid oxygen is a non-conductor of electricity; a spark taken from an induction coil, one millimeter long in the liquid, requires a potential equal to a striking distance in air of 25 millimeters. It gave a flash now and then, when a bubble of the oxygen vapor in the boiling liquid came between the terminals. Thus liquid oxygen is a high insulator. When the spark is taken from a Wimshurst machine the oxygen appears to allow the passage of a discharge to take place with much greater ease. The spectrum of the spark taken in the liquid is a continuous one, showing all the absorption bands.

As to its absorption spectrum, the lines A and B of the solar spectrum are due to oxygen and they came out strongly when the liquid was interposed in the path of the rays from the electric lamp. Both the liquid and the highly compressed gas show a series of five absorption bands, situated respectively in the orange, yellow, green and blue of the spectrum.

Experiments prove that gaseous and liquid oxygen have substantially the same absorption spectra. This is a very noteworthy conclusion, considering that no compound of oxygen, so far as is known, gives the absorptions of oxygen. The persistency of the absorption through the stages of gaseous condensation towards complete liquidity implies a persistency of molecular constitution which we should hardly have expected. The absorptions of the class to which A and B belong must be those most easily assumed by the diatomic molecules (O_2) of ordinary oxygen; whereas the diffuse bands above referred to, seeing they have intensities proportioned to the square of the density of the gas, must depend on a change produced by compression. This may be brought about in two ways, either by the formation of more complex molecules or by the constraint to which the molecules are subjected during their encounters with one another.

When the evaporation of liquid oxygen is accelerated by the action of a high expansion pump and an open test-tube is inserted into it, the tube begins to fill up with liquid atmospheric air, produced at the ordinary barometric pressure.

Dr. Janssen had recently been making prolonged and careful experiments on Mont Blanc, and he found that these oxygen lines disappeared more and more from the solar spectrum as he reached higher altitudes. The lines at all elevations come out more strongly when the sun is low, because the rays then have to traverse greater thicknesses of the earth's atmosphere.

Michael Faraday's experiments made in 1849 on the action of magnetism on gases opened up a new field of investigation. The following table in which + means "magnetic" and — means "negative," summarizes the results of Faraday's experiments:

Magnetic Relations of Gases (Faraday).

	In air.	In carbonic acid.	In hydrogen.	In coal gas.
Air	0	+	+ weak.	+
Nitrogen	—	—	--strong	—
Oxygen	+	+	+stro'g	+strong
Carbonic acid	....	0	--	— weak.
Carbonic oxide	—	—	—	— weak.
Nitric oxide	—weak	+	+	....
Ethylene	—	—	—	— weak.
Ammonia	—	—	—	....
Hydrochloric acid	—	—	— weak.	....

Becquerel was before Faraday in experimenting upon this subject. Becquerel allowed charcoal to absorb gases, and then examined the properties of such charcoal in the magnetic field. He thus discovered the magnetic properties of oxygen to be strong, even in relation to a solution of ferrous chloride, as set forth in the following table:

Specific Magnetism, equal weights (Becquerel).

Iron	+	1,000,000
Oxygen	+	377
Ferrous chloride solution, sp. gr. 1.4334	+	140
Air	+	88
Water	—	3

(Continued on page 286.)

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[*] Abstract of discourse delivered at the Royal Institution, June 10, 1892. From the "Proceedings of the Royal Institution of Great Britain," Vol. XIII, pp. 695-699.

The Commercial Possibilities of Accumulators for Tramcar Traction Considered as a Municipal Undertaking.[*]

BY ALFRED H. GIBBINGS.

(*Concluded.*)

THE ADVANTAGES OF ACCUMULATORS.

I have already pointed out that one of the greatest advantages of accumulators for electric traction purposes lies in the fact that the power of a refuse destructor may be utilized to the full, and that in consequence the cost of generating the power (both with regard to the fuel and labor) would be extremely small. But if the scheme ended here the advantages would perhaps scarcely justify the especial prominence I have given to it. It is only as the destructor is brought into combination with the central station electric lighting plant that the matter becomes supremely worthy of consideration. I am of opinion, in the first place, that no town has sufficient refuse to supply of itself the whole power required to run its tramcar service, whether by accumulators or other system. Even supposing that sufficient power could be so obtained, it would necessitate an additional capital outlay on buildings, machinery, etc., so great that it would practically be the same as for an electrical station independently worked. But where merely horse-power is available the necessary plant could readily be accommodated. The chief function and value in that case would consist in its being a "relief" station, which would obviate the running of all cars to one point only for recharging purposes. If there were more than one refuse destructor in a town, each of course could be used to form a relief station according to the number and frequency of the cars.

I have so far endeavored to point out the advantages and uses of accumulators in connection with the utilization of the power derivable from refuse destruction. I now proceed to consider a far more important matter, namely, the advantages arising from charging accumulators for electric traction by means of the available and otherwise idle plant at a low-tension electric lighting central station.

These advantages are based upon the following fact: the cell charging can be stopped at the hour when the heavy lighting load comes on, and the full capacity of the plant can then be used for lighting purposes.

This at first glance may perhaps appear a very small advantage, but its full significance consists in the fact that it provides a day load for the central electric lighting station. I have no need to here describe the *modus operandi;* suffice it to say that low tension central stations are designed for charging accumulators, and by means of independent connections those machines not running in the day or night time could be employed in charging separate accumulators for the tramcar service. As the electric lighting load came on so the different machines would be transferred from the tramcar plant to the main switchboard and *vice versa.*

The question now is, what does this arrangement actually mean both to the tramcar and the electric lighting enterprises?

The tramcar enterprise would benefit in many ways, viz.:

1. Less capital would be required, not having to provide independent dynamos and engines.

2. There would be of course correspondingly less interest and sinking fund liabilities.

3. Such expenditure as would fall under depreciation of plant, repairs, rents, rates and taxes, wages of boiler and engine attendants, etc., would be equitably divided between the electric lighting and the tramcar concerns.

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[*] Paper read before the Northern Society of Electrical Engineers, Manchester, England, December 10, 1894.

4. The management of the tramcars whilst under the supervision of an official and staff would also be controlled by a separate committee which would act conjointly with the Electric Lighting Committee.

It must be quite clear, therefore, that co-operation must very largely reduce the working costs of a tramcar system. The cost per unit, whether we calculate per horse-power-hour, per car mile, or on any other basis, must be greater where the whole cost of management and working has to be borne by the tramcar service alone than will be the case where by using the resources of the electric lighting plant handsome profits are made in what I may term "spare time."

To what extent this co-operation might be developed it is difficult to say, but the fact that each enterprise would save considerable expense to the other is perfectly obvious.

With regard to the electric lighting concern, the acquisition of a substantial day load is of the utmost possible consequence. For the purposes of this Paper it will be better to assume that this department merely charges (as an electric lighting enterprise pure and simple) for the current which it can generate and sell. That is, I do not wish to complicate what I have to say by assuming any arrangement between the Electric Lighting and Tramcar Committees with regard to sharing the proportions of the costs under the various items common to both enterprises. It will be sufficient if we assume that:

1. The Electric Light Committee retain their independent position and make a definite charge per unit for all current supplied.
2. That this output is merely considered as a day load.

The endeavor to solve the problem of a day-load for the central station has resulted in the suggestion of many different methods, but most of these methods at the best would only make use of a very small proportion of the available power.

I will give actual figures from the working of the electric lighting station at Hull. These may be absolutely depended upon, as we weigh all coal, all ashes, and measure everything consumed. The units generated and delivered are checked in four ways: *first*, by Aron meters in the circuit from the dynamo to the switchboard; *second*, by the working out of daily load curves taken from readings on the ammeters; *third*, by Edmondson meter in the main omnibus bars between the switchboard and the several feeders; *fourth*, by quarterly comparison of the consumers' meter readings. All these we find agree within a small percentage.

Our lightest weekly output during this summer cost us .97d. per unit delivered (not generated), including coal at 14s. per ton, and oil, water, waste and all stores. Our heaviest weekly output during this winter has cost us .60d. per unit for the same items.

Now, with regard to the standing charges just referred to, if we multiply the heaviest weekly output by 52, or in other words, if we assume the maximum weekly output as the average weekly output, I find that the proportionate cost of the standing charges comes to 1.84d. per unit. Adding both these costs together, that is, the generating cost and the standing charges cost, we get:

Generating cost............................	.60d.
Standing charges cost..................	1.84d.
Total...	2.44d.

as the representative total cost per unit for one week, and I have no need to add that I only wish the figures were true for every week in the year.

The maximum electrical power used during this model week was 450 for an average of three hours per day, or 9,450 E. H. P. hours out of a possible 75,600.

Now a minimum number of small cars, say thirty, averaging 10 E. H. P. each, would give (neglecting charging losses) 300 E. H. P., which for ninety hours in the week is equivalent to 27,000 E. H. P. hours, or an increased output of at least three times the usual quantity. As the power required by the tramcars would not vary with the season of the year, but would remain fairly constant, it is possible that this supply would form by far the largest factor of the output for some years.

You will at once see my object in giving you these figures. The generating cost of course will remain the same, viz., .60d., but the standing charges cost will be reduced to one-third, and the gross cost per unit becomes 1.21d. only for all current generated.

This figure gives us a very high efficiency, in fact the very highest efficiency which has ever been obtained from any electric lighting central station in the United Kingdom, or I venture to say anywhere in the world. This demonstrates clearly what the co-operation of accumulator cars will do for an electric lighting station, and it may be definitely stated that the combination guarantees a better load factor for every week throughout the year than is obtained by the highest weekly output of the electric lighting alone. It would mean that an enormous profit would accrue to the electric lighting business itself if only 3d. per unit were charged, and the first possibility which is immediately suggested is that of the great reduction which might be effected in the usual price per unit for current. But we must not forget that this possibility is essentially due to the creation of a magnificent day and night load. I am of opinion, therefore, that the standing charges rate should not be divided equally between the tramcar and the electric lighting concerns, but in the inverse ratio of their demand in units throughout the year. In thus charging the users of the electric light with the larger proportion of the standing costs it would be possible to confer a still greater benefit on the traction enterprise by bringing the whole of its charges to within 1d. per unit. This price, which includes interest and sinking fund, capital, wages, and power, as far as the generating machinery is concerned, will be found to be a much lower figure than has ever been obtained with any system.

You will have observed that the arrangement therein suggested is essentially based upon those facts of which we as engineers are certain. I have endeavored to entirely eliminate dubious or insufficiently tested possibilities, such as thermal storage, and I have avoided the unnecessary procedure of basing my proof upon comparisons of the working cost per car mile of the different systems, as such figures are generally misleading and in most cases do not form any proof at all. Admitting and including the heavy depreciation of the accumulator plates, it has been my object to show how accumulator traction can be worked cheaper and more satisfactorily than the other two systems. Hence my ideas are placed before you rather in the abstract than in the concrete. With reference to my figures representing the power obtainable from our refuse destructor, or, for that matter from any other refuse destructor, providing the requisite quantity of refuse is present, I merely wish to point out that Mr. Jones, of Ealing, estimates for the same number of cells, destroying the same quantity of refuse as at Hull, a continuous power of 50 I. H. P., while I have placed my figures at 45 I. H. P. The refuse at Hull is in fact of a drier and more combustible nature than that at Ealing, so that my estimate may be taken as well within the mark. I have had the advantage of seeing the Ealing Destructor Works, and my assertions therefore may be taken with every degree of assurance.

DIRECT CURRENT MOTOR AND DYNAMO DESIGN*—III.

BY GANO S. DUNN.

DISCUSSION.

Dr. Charles E. Emery—I have been very much interested in what has been said here to-night, and much pleased with the clear and thorough way in which it has been expressed. I have had some, perhaps unusual, opportunities to investigate these particular matters and have been surprised at the want of candor of very many in speaking of these subjects, particularly in relation to sparking. Very many would be surprised to know the numerous theories there are on the subject even among those who have written books on it. Now that it has come down, as I had fully made up my mind that it would, to the two points of the forced commutation and the induction, as has been so fully described to-night, it is certainly very gratifying to have it put forth so clearly and without the least attempt to make a mystery of it or to conceal anything. The young gentlemen here present may be very much gratified at having the whole matter, in a sense, thrown open to them.

There is still another point that is directly in this line, although led into it from a different direction. In ascertaining the efficiency of a dynamo it is very common to obtain the core loss and friction of the engine light, then to excite the fields and obtain the armature drag by subtracting the second set of observations from the first. Now, the two quantities thus obtained it is customary to use as the armature drag and the friction throughout the whole range of the experiments. Experiments showed very clearly that this is incorrect, for the reasons which the lecturer set forth here to night. The armature drag increases quite materially as the load rises; the exciting force is necessarily increased first to balance the drop through the coils—to balance the lost volts, it is sometimes called. But there seems to be some reaction there independent of that. At any rate, summing the energy used in the shunt and series fields the amount increases in a very much larger ratio than the power. That necessarily increases the armature drag, and so there is no way of balancing the indicated horse-power with the electric work but by taking that into consideration; and it shows very plainly that the proper way to make tests in cases of that kind is by separate excitation, or by putting on more shunt field without using the series field to make a series of progressive tests, and bring up the voltage by the increased field and find the losses when the armature circuit is open for each of those progressive loads, and then those subtracted from the full load or added together and compared with the external output, really give the efficiency. The efficiencies of these standard machines are lowered by this method and it is one reason why we find in practical circumstances that those large efficiencies are not obtained. It is not very great, but when we come to these new machines a matter of 2 or 3 per cent. is considered very large, and there is that difference to be accounted for in that particular way. There is one other matter, when others have discussed the subject, to which I would call Mr. Dunn's attention, and that is that in his first diagram he told us why the characteristic took the form. Now we possibly can study out why the other characteristic took the form, but he did not happen to mention it. I do not know whether he intended to or not. We should be happy to hear if he wishes to explain the matter.

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* Lecture delivered before the New York Electrical Society November 27, 1894.

Mr. Tesla—[The first portion of Mr. Tesla's remarks were rendered inaudible by a passing locomotive.]—All these beautiful windings shown by Mr. Dunn are due to Mr. Weston. The lecture which we have just listened to has been to me, I can assure you, a great pleasure. I cannot but congratulate professors of Columbia College in having a pupil who is able to so address an audience on this subject. I remember that in these halls I presented some years ago my first work on high frequency pheunomena, and it was Mr. Dunn who first of all the students here aided me, and I remember how I felt, as he no doubt has felt this evening, in addressing for the first time an audience, and I remember how grateful I was to him for the assistance he gave me at that time. It has been a great pleasure to me to be here, not only because I have had this evening's enjoyment, but because I have felt that my first idea of Mr. Dunn was a correct one, and that we may expect from him valuable work.

Dr. S. S. Wheeler—As Mr. Dunn has touched on the subject of regulation of dynamos, we might try to induce him to speak on the regulation of dynamotors. I think this is an interesting subject, though it does not properly belong to this one.

Dr. Geyer—Mr. Dunn explained very lucidly the matter of brushes of various resistances and that we are between two difficulties: of getting too high resistance, or, if the resistance is too low, getting too much sparking. I was going to ask if he knows of any brushes being used that are individually graduated—to have, say, a good conductor for a foundation and a brass conductor over it for the next grade of conductivity, and so on worse and worse—say that the thickness of your brush was made up of copper, brass, good conducting carbon, poor conducting carbon.

Mr. Dunn—I will answer first Mr. Emery's question concerning the shape of this second curve which was drawn. The curve was shaped like this (B, Fig. 1). The fact that the curve B does not rise as high as the curve A at that point (B) is due to these two reasons: the B motor is expected to give 300 per cent. load for short periods without sparking; therefore, in the first place, it is very large and strong and tough and its bearing friction is large; also its commutator has to carry very heavy currents. Then, again, in order to be sparkless it has to be a machine in which there is a great deal of iron and very little copper, a great many lines of force in the armature and very few turns on the armature to distort those lines of force. Therefore the hysteresis is large and the eddy currents are large and the field, in order to go around such an amount of iron, is also large. That makes the fixed losses very large, and for small loads, such as this, the fixed losses bear so large a proportion to the total output that the efficiency is small. As the losses that increase with the load are small with this type of machine, they do not come in and cause the curve to bend down as it does here, and so the curve rises up to this point.

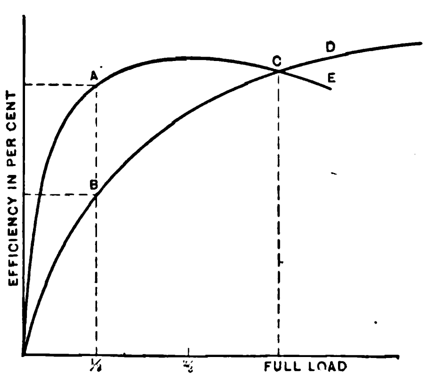

Fig. 1.

With regard to the brush mentioned by Prof. Geyer, such a brush is the Worth brush, which is made up of copper leaves, in the middle separated by paraffine paper, then a lamina of some other material of higher resistance than copper, then lamina of some other material higher yet—all separated by paper. Those brushes are excellent for low voltage machines, but for high voltage machines even the resistance of german silver is not enough to cause the forced commutation. With regard to making the carbon in different resistances throughout, that would unquestionably secure the end that Prof. Geyer suggested, but those carbons are made of an admixture of clay and molasses. It is liquid almost, and it would be difficult to properly make those together; it would be much easier to make a brush of high resistance material all through and make it so much wider. Widening the brush would have the same effect as making the parts of higher conductivity.

With regard to the regulation of dynamotors, the dynamotor is a machine in which the armature is wound with two windings, one of which drives the core and the other of which by passing the same field generates the electromotive force and acts as a dynamo. You cannot change the dynamo voltage, because if you do, while it gives you more lines of force to be cut, yet it makes your motor go just that much slower. To make a motor dynamo which regulates you must have it arranged so that all the lines of force that act on your motor do not act on your dynamo. Then by varying the lines of force that act on your dynamo only you can get a variation of voltage such as that by simply connecting together a motor and dynamo, then by varying the fields of the dynamo only a change of potential can be secured. It is also done in this way: The motor windings are wound as usual. The dynamo winding, however, is extended out on a little additional core, and then a little extra field magnet properly placed can inject lines of force into this little core and those lines of force will have an effect on the dynamo field without any effect on the motor, and therefore the potential will rise.

Mr. Perry—I would like to ask Mr. Dunn in regard to a device which we all saw at the Electrical Building which was presented by one of the German exhibitors and in which a polar ring was used. Herr Altenau, who was in charge of it, spoke of it very highly, and I believe it was attributed to Dobrowolski. One of the claims that he made for it was that it would stop sparking, but I have seen that machine spark quite as violently as machines without the polar ring.

Mr. Dunn—The principle of the Dobrowolski magnetic shunt is this: If we have a four-pole machine we want to get a fringe at the horn of the pole to stop our sparking. Now in very intense fields we move our brushes till we get just where we will get the right amount of fringe to reverse. If we move them a little bit too far we will get so much more fringe than is necessary that they will spark very badly, and if we do not move them quite far enough we will not get enough fringe to reverse them. In other words, the entrance of the brush under this fringe is too sudden. That fringe is reacted upon by the armature reaction, and if when the brush is under the fringe the load should be removed, which allows the fringe to come back, it would come back and lap over the point of commutation a little bit and would cause a sparking. Mr. Dobrowolski puts inside his fields a thin layer of cast-iron. At first sight it would seem that that cast-iron tube would cause a large amount of magnetic leakage from pole to pole and be of no value; but he bores it full of holes right in the middle between the fields so that he does not cause much leakage, and it has the effect of causing a gentle distribution of this fringe all of the way across. But if there is much of an armature distortion the fringe that has been driven away has to come a long distance to get back. In other words, it makes an equable distribution there and helps your commutation. As to how effective that device is I do not know. I should think that for machines in which the coils are not slipped right over the pole pieces about the same results could be accomplished by chamfering off the edge of the poles and properly shaping them.

Dr. Emery—Perhaps it would be of interest to those present if the speaker would explain the Sayre winding.

Mr. Dunn—The Sayre winding. On this diagram (Fig. 5) there is not going to be any fringe over the brush to start an electromotive force in the coil when it gets under there, because it is too far away from either of the magnets. Now if I shift this brush backwards and cause the commutation to take place under one horn or the other horn of the magnet, I have shown how it weakens the field very much. Now the principle of Mr. Sayre's device is that the little load to the commutator block which is going up, before it is allowed to touch the windings comes over under the pole and in a separate winding wound on the same core just wraps itself around there a few times and then goes back and then goes up. Now with the brushes in the position shown that little winding which is under the pole piece generates the electromotive force which is necessary to cause this coil to reverse right where it is without the necessity for shifting the brushes. Another point in Mr. Sayre's winding is that by separating this little coil from the main one he can put it either under the weak pole horn, or he can put it under the opposite horn and wind it in the opposite direction and it would have the same effect. You notice how this machine sparked when it ran backwards. Now Mr. Sayre uses that reactive field to prevent sparking. It is a very complicated winding and has not as yet been used in practice that I know of—not certainly to any great extent. It requires two different windings, the regular winding to do the work and then this secondary set of windings in each of these little commutator wires to do the reversing. But the principle of it is splendid.

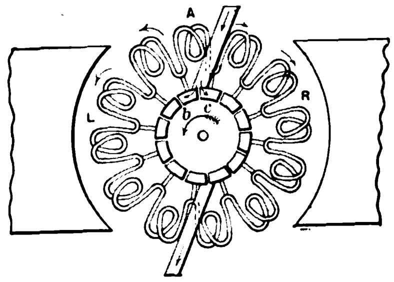

Fig. 5.

Dr. Emery—I recently had a letter from one of the representatives of the General Electric Company in England who has been investigating the matter, and he said that it overcomes a great many of the difficulties of the design of dynamos. The winding, although complicated, as spoken of, can be of very small wire, because the separate coils only come into connection as they come under the brush, and therefore they have time to cool until they can come under, so that although I was not impressed with it at first, there is a second paper of Mr. Sayre on the subject in which he states that he has put them in a great number of machines and reduced the size very materially. It was not necessary to have even as much iron in as before. He did not pay any attention to this question of armature reaction except with the coils, and took it all out, and in that way was able to reduce the weights very materially and yet accomplished the results very satisfactorily.

A Member—I would like to ask about the exact ratio between the width of the slot and the size of the air-space.

Mr. Dunn—That ratio in a small machine, when the air-gap is one-eighth of an inch, may be three eighths without very much loss, but if it is made a quarter the loss is very insignificant. Two to one is a good ratio in small machines. In large machines the width of the slot is made equal to or a little less than the air-gap. But in small machines the width of slot twice the length of the air gap gives no trouble. The loss due to it is perhaps one-half of 1 per cent.

Dr. Emery—If there are no further suggestions I would like to express my own thanks for the very able manner in which this subject has been presented by one that we have learned to admire, and I wish to move a vote of thanks to the lecturer of the evening for his very able and interesting lecture.

The motion was carried and the meeting adjourned.

CROCKER-WHEELER ELECTRICAL COMPANY,
Manufacturers and Electrical Engineers,
39 and 41 Cortlandt Street,
NEW YORK, Dec. 10, 1894.

To the Editor of ELECTRICITY.

DEAR SIR: During the discussion of Mr. Dunn's recent lecture before the New York Electrical Society at Columbia College, on the "Designing of Electrical Motors," I understood Mr. Tesla, in a very neat speech of praise of the lecturer, to mention as a matter of little consequence, in view of his praises, that all of the devices, windings, etc., described were very old, and that the windings especially were attributable to Weston. I was considerably surprised at this, although Weston is entitled to more credit than he usually receives for being the originator of much that is good.

Among other things, Mr. Dunn explained what is known as the four-pole, two-brush or two-circuit winding for drum armatures and its mate for ring armatures, and in view of the fact that the Crocker-Wheeler Electric Company have spent much time and a great deal of money investigating the merits and true ownership of these windings, and securing the rights to them from abroad, I was surprised to hear them attributed to Weston, especially as I was not aware that he had ever done much in multipolar construction.

I was immensely pleased with the spontaneous outbursts of praise from a number of prominent gentlemen, amounting almost to an ovation. I can justly add that the conscientious ability of the lecturer has contributed very materially to the success of our company. Yours truly,

SCHUYLER S. WHEELER.

An English paper states that experiments recently made by the Commissioners of Police on the Thames at night with an arc searchlight deriving its current from a Skrivanow primary battery have been succeeded by the successful adaptation of that battery to portable glow lamps for domestic purposes. To this end a battery of small size, but considerable power, is placed in the base of a lamp standard, the glow lamp being mounted on the top in place of the ordinary burner. Most of the usual forms of duplex, moderator and other lamps of that class can be utilized for this purpose. The special features of the Skrivanow battery are absence of fumes, small capacity and great electromotive force, this being put at about one-and-a-half volts for each element, which is only one inch in width. Each cell consists of a packet of chloride of silver and two thin zinc plates, a weak solution of caustic potash being added. This battery produces an excellent light through a glow lamp of Italian make, and it was stated that the light would continue thus bright for twelve hours. At the end of that time there would be no waste of the elements, but the chloride of silver would have become converted into pure silver, and would require to be revivified. This is effected by washing it in a solution of nitric and hydrochloric acid. This restores the silver to its active condition, and it is replaced in the battery ready for use again. It is stated that after long use the silver is just as valuable as when first placed in the battery.

A paper read before an institution of standing, but inadequately discussed, may often do more harm than good.—*London Electrician.*

CALCIUM CARBIDE AND ACETYLENE.*

If the problem of producing aluminium in great abundance and at a sufficiently low cost by direct reduction of clay has not yet been satisfactorily solved, the immense amount of experimental work which has been done in the endeavor to solve it, from the time of Sir Humphry Davy down to our own day has been amply repaid, not only by the vast increase which it has added to our knowledge and experience of electrical smelting, but by certain other developments of great industrial importance which well merit the attention of chemists and engineers. It has proved to us, for example, that under the conditions of intense heat, only obtainable in certain forms of electrical furnaces, the most refractory alkaline earthy metals may be deoxidized and formed into definite and more or less stable compounds with carbon, as may be demonstrated by the equation $CaO + 3C = CaC_2 + CO$, and there is thus opened up to us quite a new field in industrial organic chemistry. It is true that these compounds have long been known to us, but it is equally true that they have not been produced commercially for the reason that we have hitherto been unable to secure the intensity of temperature essential to their commercial production. In the year 1836 a by-product was obtained in the preparation of potassium, which decomposed water and gave off acetylene (C_2H_2) and which was found to be a compound of carbon and potassium. At about the same time Wohler made carbide of calcium experimentally by subjecting to a high degree of heat an alloy of calcium and zinc mixed with charcoal, and found that it could be used for the production of acetylene. There was nothing of industrial consequence, however, in these discoveries, nor does anything appear to have been accomplished to attract attention to the carbides until the early part of 1892, when L. Maquenne (Comptes Rendus [115] 558-561) prepared barium carbide (BaC_2) by heating in an iron bottle 26·5 grams barium carbonate, 10·5 grams powdered magnesium and 4 grams charcoal. He kept the bottle in a Perrot furnace for 4 minutes and found that the following reaction took place:

$$BaCO_3 + 3Mg + C = BaC_2 + 3MgO.$$

The cooled mass was amorphous, bluish gray and friable, and 100 grams of it yielded 5,200-5,400 c. c. of acetylene, mixed with some $\frac{2}{3}$ per cent of free hydrogen. The curiosity awakened by these results led to further investigation, and in a short time W. Travers (Proceedings of the Chemical Society of England [118] 15-16) devised another, although very similar, method of obtaining acetyline in comparatively large quantities. In the place of magnesium Travers used metallic sodium and a mixture of powdered calcium chloride and dried gas carbon (1:4). After properly closing his iron bottle and heating it in a furnace to a red heat for 30 minutes, he removed and cooled it with water. The brittle, bluish-gray mass when broken out was in this case found to contain about 16 per cent. of calcium carbide (CaC_2) with some free carbon and some chloride and cyanide of sodium, and it gave off acetylene in satisfactory quantity when thrown into water.

When Maquenne and Travers were working on these lines, Mr. Thomas L. Willson, of the Willson Aluminium Company, was carrying on experiments in the manufacture of aluminium and calcium alloys at Spray, N. C. In the progress of these experiments, and while attempting to produce metallic calcium in his patent electric furnace, he succeeded in making, from a simple mixture of lime and carbon, and with a current of 4,000 to 5,000 amperes, a fused, black, homogeneous mass, which became solid and brittle when cooled. This substance was shown by analysis to be very pure carbide of calcium, of the formula CaC_2, and the gas which it evolved from the decomposition of water was pure acetylene, formed according to the reaction

$$CaC_2 + 2H_2O = C_2H_2 + CCa(HO)_2.$$

This contribution to organic chemistry of a plentiful and cheap source of acetylene, by so easy and simple a method of making calcium carbide, must be regarded as one of the most important of the valuable resources added to the chemical industry by electrical engineers, and the Willson Aluminium Company has shown its appreciation of it by continuing to manufacture the carbide on the small scale. A new corporation has also been formed, which is known as the Electric Gas Company, and which proposes to erect a large new plant for its wholesale production. The electrical furnace that is to be used is shown in the illustration, and was invented and patented by T. L. Willson on February 21, 1893, patent No. 492,337, his application having been filed in August of the previous year. A shows the outer masonry shell or bench of the furnace, B the carbon or graphite crucible or hearth, C the carbon bar or pencil constituting the movable electrode, and D the dynamo for generating the currents. From the terminal brushes of this dynamo one wire w leads to and communicates with the crucible B, while the other wire w' leads to and communicates with the carbon pencil C. The connections are preferably made in the manner shown, the wire w being connected through a fastening bar a to an iron plate b underlying the crucible B, and the w' being connected to a metal socket c embracing the upper end of the carbon pencil C. The bench A is made preferably of firebrick, which is a non-conductor of electricity, and the furnace is covered over with a plate, or preferably two plates E E of carbon having a central hole through which the carbon pencil C projects down into the crucible. For tapping out the resulting product, a tap-hole d is formed which in operation is closed by a plug e of alumina, clay or other suitable refractory material. The carbon plates E, E, rest on the top of the firebrick walls A, which project above the top of the crucible, forming an intervening space f for insulating purposes to prevent the short-circuiting of the furnace between B and E. For the vertical adjustment of the carbon pencil, a screw-threaded shaft g is provided which may be propelled up and down by the engagement therewith of a suitably mounted rotative nut h.

Without entering into a detailed description of his process, its main features may be broadly stated as decomposing, deoxidizing, or reducing refractory metallic ores or compounds by subjecting them, while intimately commingled, or mixed with an excess of finely divided carbon, to the continued heat of an electrical arc. The mixed material being between separated electrodes and the arc being quite close to that portion immediately under treatment, the formation of a bath of fused compound, and the consequent ebullition and fluctuations in the resistance of the arc, are prevented by the presence of the carbon.

As the actual result of its recent practice, the Willson Aluminium Company has found that it can produce one short ton of calcium carbide from a mixture of 1,200 lbs. of fine coal dust and 2,000 lbs. of burnt lime, and at an expenditure of about 180 electrical H. P. per hour for 12 hours. These figures are not very far from those required by theory, and they agree very closely with those given by H. Moissan, who has also produced the carbide in an electrical furnace of his own invention. It would, therefore, seem safe to formulate the approximate cost of production somewhat as follows for both the carbide and the acetylene:

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*Specially written for "The Engineering and Mining Journal" (New York), by Francis Wyatt, Ph. D.

1,200 lbs. coal dust, say	\$2.50
2,000 lbs. powdered burnt lime	4.00
180 E. H. P. from water at, say, 50c. per hour for 12 hours	6.00
Labor, etc	2.50
Cost per 2,000 lbs. CaC_2, say	\$15.00
Cost per 2,000 lbs. C_2H_2, say	\$37.00

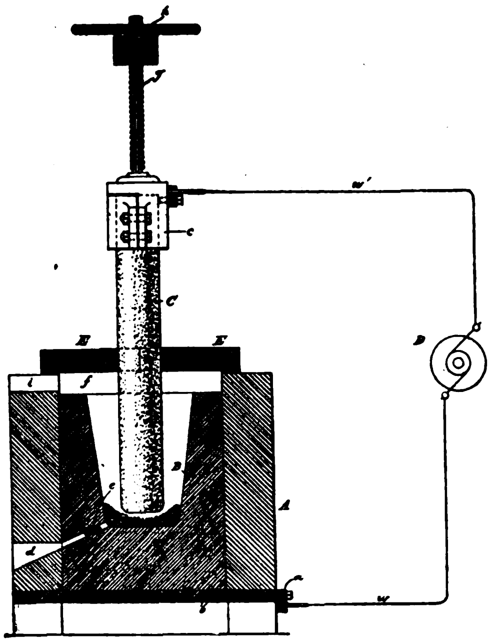
These figures would hold good, not only for the present works in North Carolina, but at any other place where cheap water power and equally cheap coal, lime and labor are procurable and accessible.

The specific gravity of calcium carbide is 2 22 at a temperature of 18° C., and, as may be judged from its formula, it is practically insoluble in all the ordinary reagents. Its qualities and characteristics have not been fully investigated, but Moissan has found that it may be heated in hydrogen gas, or exposed to nitrogen at 1,200°, or to the contact of silicon or boron at a bright red heat, without undergoing any change, and that it is not affected by sodium or magnesium at the softening point of glass, nor by tin at a red heat. At a higher temperature than a dull red heat it alloys with iron, and this is well worth noting because it may be of interest in the future industry of steel. It becomes incandescent in contact with chlorine, bromine and iodine at the respective temperatures of 245°, 350° and 305°. It burns in oxygen, with formation of calcium carbonate, at a dull red heat and at 500° it becomes incandescent in sulphur vapor, and yields calcium sulphide and carbon bisulphide. Water is decomposed by it very rapidly and with evolution of pure acetylene, but its action upon steam is not so rapid, even when it is red hot, and the gas evolved is not pure acetylene, but contains free hydrogen. In dilute acids it behaves in the same way as with water, but it is only slightly attacked by fuming nitric and sulphuric acids, although ordinary sulphuric acid readily decomposes it, giving off an odor of aldehyde. Dry hydrogen chloride makes it incandescent, and the gas evolved contains a large proportion of hydrogen. With fused chromic anhydride it forms carbonic anhydride with incandescence, but with a solution of chromic acid it produces acetylene only. It is oxidized by potassium chlorate or nitrate at a red heat with incandescence, and formation of calcium carbonate. Lead peroxide oxidizes it with incandescence below a red heat, the reduced lead containing calcium, and it becomes incandescent by trituration with lead chromate at the ordinary temperature.

This rapid summary of the results of preliminary investigations would seem to strengthen the opinion, already expressed, that calcium carbide chiefly claims our attention as a practically unlimited and most convenient source of pure acetylene, and there is little reason to doubt that its utilization in this direction will soon cause it to be manufactured extensively in this and other countries.

The hydrocarbon acetylene is regarded by chemists, and very justly so, as one of the most important intermediate bodies in the synthesis of organic compounds from their elements, and as one of the most interesting of the entire series. It is the only hydrocarbon that can be prepared directly from its free elements when the electric arc passes between carbon poles in an atmosphere of hydrogen, and it is worthy of consideration that this combination involves heat to the amount of 61,000 units. This tremendous energy explains why the sudden decomposition of acetylene evolves enough heat to raise the temperature to 3,000°, and why the intense molecular vibration produced by detonating a minute quantity of mercuric fulminate in 25 c. c. of it causes a violent explosion, accompanied with production of free hydrogen and finely divided carbon. It has been hitherto produced for commercial purposes by the incomplete combustion of coal gas according to the equation : $4CH_4 + 3O_2 = 6H_2O + 2C_2H_2$, and its purification has been effected by passing it through an ammoniacal solution of cuprous chloride and subsequently decomposing the red precipitate with dilute hydrochloric acid. This is, of course, a very costly and tedious operation, and is rendered a somewhat dangerous one by the highly explosive nature of copper acetylide.

It is a colorless and highly explosive gas, of very disagreeable smell, of specific gravity 0·91. It burns with a very smoky, but much more luminous, flame than olefiant gas and undergoes complete combustion when mixed with oxygen in the proportion of 1 : 2½ vols. At a temperature of 1° C. and a pressure of about 725 lbs. it becomes a mobile and highly refractory liquid much lighter than water, whereas by heating it in a sealed tube it is converted into a mixture of benzine (C_6H_6) and styrolene (C_8H_8). By passing sparks through a mixture of acetylene and nitrogen, hydrocyanic acid may be synthesized from its elementary constituents $C_2H_2 + N_2 = 2HCN$, and from this there may, of course, be produced the whole of the cyanides and a large number of other important organic bodies. If the red precipitate of cuprous acetylide be treated with metallic zinc in a solution of ammonia, nascent hydrogen is produced and ethylene or olefiant gas (C_2H_4) is formed. This in its turn can be combined with sulphuric acid to form sulphethylic acid ($C_2H_4 + H_2SO_4 = C_2H_5HSO_4$); and this on being distilled with water yields alcohol. $C_2H_5HSO_4 + H_2O = C_2H_6O + H_2SO_4$.



WILLSON'S ELECTRO SMELTING FURNACE.

The fascinating scope for intelligent and painstaking research thus opened up in so many and so varied directions, must strike all those who are in any way interested in organic chemistry as practically boundless, and the results will undoubtedly be revolutionary. For the purpose of giving us better and cheaper illumination than the ordinary coal, water and oil gases, acetylene is already occupying much attention, and it is from this direction that results will in all probability be first made apparent. The hydrocarbons of the ethylene and acetylene series give the illuminating value to gas made from the distillation of coal; while the illuminating value of water gas is derived from a mixture with the non-luminous gases of the same series of luminants obtained from the vaporization and cracking of petroleum oils. Since the power of the illuminants in any gas is in direct ratio to the relative proportion of its carbon and hydrogen, it must be plain that acetylene (C_2H_2), on account of its great proportion of carbon, must be highly diluted to prevent it from burning with a smoky flame. When, however, it is diluted by mixture in proper proportion, either with water gas or with ordinary atmospheric air, its flame is smokeless and of the utmost brilliancy and whiteness. The experiments that have been made by the Electric Gas Company have satisfactorily demonstrated that one short ton of calcium carbide will produce, by merely mixing it with water, about 10,500 cubic feet of acetylene, which, when mixed with the required amount of air, produces a gas equal in illuminating value to 100,000 cubic feet of city gas of 22 to 25 candle power per 5 feet standard burner. If to the estimated cost already given for the calcium carbide there be added say \$15 per ton for freight, incidentals and profit, the material for producing such a gas could be obtained at nearly all points for 30 cents per 1,000 cubic feet ready for burning, and the convenience with which the calcium carbide can be packed and freighted, combined with the easy preparation of the gas itself in great or small quantities, at any time, should enable it, if not to be adopted for the common supply of large cities, to supply the requirements of country hotels and dwelling houses and of railway cars.

THE COST OF TELEGRAPHIC BLUNDERS.

Defective Apparatus and Climatic Influences Legally Considered.

BY R. D. FISHER.

The tide of adjudications, as viewed from recent cases, seems to be gradually and unmistakably turning against the doctrine that an electric telegraph company may relieve itself of liability for blunders in the service rendered to the public by stipulating that it will be liable only for "repeated" service beyond the amount paid for the service desired. There are many errors made in the transmission of messages which are either due to lack of care or skill or defective electrical apparatus. Expert and skilful service and the most improved apparatus are indispensable requisites to the modern transmitter of messages. Without these the risk of damages is burdensome, and even with all these the risk is very great. In the past there has been a substantial conflict of authority upon the subject, but a more general rule is being adopted as the intricacies of the electrical age are becoming better known. These risks may be divided into three heads: (1) Operators' blunders; (2) defective apparatus, and (3) climatic influences.

An error of the operator or fault of the system which has cost the sender many dollars and the companies many expensive suits and substantial judgments is the mixing of the numbers 15 and 50. Operators are at a loss to account for its frequent occurrence, and because of that fact notices are usually posted above each instrument warning the operator concerning it. Notwithstanding this precaution, much damaging litigation has resulted, and perhaps the recent case decided by the Supreme Court of Georgia (Western Union Co. vs. Blanchard) and that of White vs. Western Union Co., rendered by the United States Circuit Court at Leavenworth, Kan., are among the more important. The plaintiffs, who were merchants in A., delivered to the operator of the defendant at that point for transmission to merchants in St. L. the following message : "Sell 15 July wheat; sell rye 52 or more." The receiver's dispatch read fifty instead of fifteen, and in consequence the receiver sold 50,000 bushels of July wheat instead of 15,000 as instructed, and hence resulted the damage complained of. Notwithstanding the paper upon which the dispatch was written was a form furnished by the telegraph company limiting and restricting its liability in the transmission thereof, in substance forms the contract upon which the message was accepted, yet one thing in particular sought for in this contract to relieve the defendant from liability which the law will not permit is that it cannot be released from damages by the culpable negligence of its employees. If this or similar blunders arise from the culpable negligence or gross negligence of employees then the company is responsible, because the law imposes upon the company a high degree of care and diligence upon the part of its employees to transmit messages safely and correctly.

Losses of considerable amounts are frequently charged to operators afflicted with paralysis. It is said they cannot control their movements and often make too few or too many dots. Aside from blunders of a costly character, many have occurred that are of a ludicrous and amusing kind. Among the many errors of this kind, we note one concerning the record of a drowning man. After detailing the piteous scene and the brave efforts to save his life, the dispatch read: "Just as brave John Smith reached his side he threw up his hands and with a look toward heaven cried out 'Ninety-nine!'" This was so unexplainable as to occasion the operator to send back for information, and was told by the sender that it did not mean "ninety-nine," but "Lulu," the name of his sweetheart. The characters made to represent the one are the same as used to represent the other.

DEFECTIVE INSTRUMENTS.

In the various and somewhat conflicting decisions on the question presented, we are inclined to hold that the contracts relied upon do not, and cannot, exonerate the electric companies from the use of ordinary care and diligence concerning the skill of their operators, but also and especially as to the condition of their instruments. If an error occurs by reason of defective instruments, or by a momentary displacement of the wires, the electric company knows it, or ought to know it, and in a trial for damages there is no reason why the rule should not be the same in regard to telegraph companies as to that of railway companies, for they are alike public institutions with duties owing to the public. (See Tyler, Ulman & Co. vs. Western Union Co., 60 Ill., 421.)

On general principles it is safe to hold that an electric telegraph company serving the public as a transmitter of messages for hire, notwithstanding the special conditions relied upon, is responsible for mistakes happening by its own fault, such as defective instruments, as well as carelessness or unskilfulness of its operators, but not for mistakes occasioned by uncontrollable causes. (See Sweatland vs. Tel. Co., 27 Iowa, 433.)

The phrase "other causes," usually incorporated in these contracts, cannot be allowed to embrace defective instruments, for the companies are bound by their obligations to the public to provide the best instruments and of the most approved construction. Defective apparatus and unskilful operators appertain to business and public employments in other lines. A railway company cannot be excused on failing to employ competent engines and servants to manage and conduct them, and if a loss occurs by reason of such inefficiency or incompetency they are liable. Why not apply the same rule to a telegraph company and hold that they, too, must be confined to mistakes due to the infirmities of electric telegraphy, which alone are unavoidable.

ATMOSPHERIC OR CLIMATIC INFLUENCES.

Modern telegraphy is no longer an infant art. It sprang into existence from the teeming brain of a genius who had the boldness to attempt, against great difficulties and critical opposition, to render subservient to the wants of humanity the most subtile element of nature, and by its mysterious potency convey ideas, wants and wishes to the remote corners of civilization, and that, too, with the speed of its kindred element. In its primitive stages it scarcely ever failed to perform its office well. A half century has witnessed vast and almost miraculous improvements in the scientific art—a higher knowledge of the subtile agent or force called into use—more finished and perfect instruments, and almost perfect skill in those who operate them; so that atmospheric causes alone, which have not yet been wholly provided against, stand out against the asserted and incontestable truth, that, with a line of wire properly constructed, the most perfect instruments and skilled operators, with proper care, messages are sure to reach their destination exactly in the words and figures in which they are flashed by the sender. The art is reduced to a certainty aside from atmospheric causes. That courts are growing less swift to exempt these companies from liability is a dictate of public policy. To such perfection has the art reached that a blunder or mistake in the transmission of business is *prima facie* evidence of negligence, and in an action of law the burden is on the electrical company to show the contrary. Indeed it is said to be "necessary," upon grounds of public policy, that such companies should be held to a more strict accountability than ordinary bailees. (See De Rutte vs. Tel. Co., 1 Daly, 547.)

If a message is accepted the company is bound to transmit it correctly; failure to transmit can only be excused by reason of storms or other atmospheric influences. (Tel. Co. vs. Cohen, 73 Ga., 522; and White et al. vs. Tel. Co., 14 Fed. R., 710.)

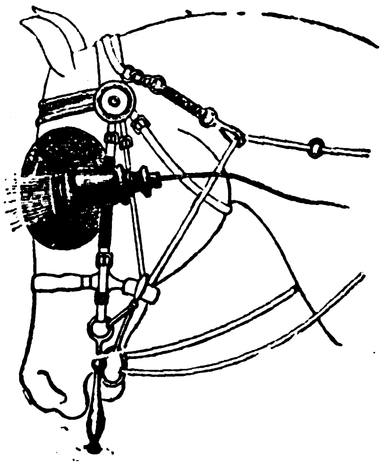
In the case of Sweatland vs. Ill. and Miss. Tel. Co., 27 Ia., 432, it was held that a stipulation was reasonable and valid as to errors in "unrepeated messages, occasioned by unavoidable or uncontrollable causes, provided proper instruments have been adopted for use and proper care and skill exercised by the company's operators to avoid or prevent the mistake." But, in the light of recent decisions, we deny that electric telegraph companies can adopt general printed rules, exacting, as a condition of sending messages, that the sender shall exonerate or release the company from damages occasioned by blunders on account of lack of proper skill in the operators, or by their failure to use due care, or by defective instruments. Unforeseen, unavoidable atmospheric disturbances alone will relieve such a company against responsibility in the performance of the service or duty which it undertakes to render to the public.

Horse owners should understand that their animals are peculiarly liable to injury from contact with electric currents. This is not due, according to the London *Lancet*, to the physical structure of the horse, but to other causes, some of which are in a degree preventible. The safety of the horse depends upon the skill of the blacksmith to some extent. The authority named points out that the shoes offer a large surface for contact and the nails are conductors by which the current may enter the body, although the sole of the hoof itself is an insulator. The animal's weight aids the contact, and a wet fetlock increases the danger. Blacksmiths, therefore, should not drive the nails to the "quick," and the fetlocks should be trimmed.

Queen Victoria will use electricity for cooking purposes. The necessary apparatus has been installed at Osborne, in the Isle of Wight. It is, however, only used for the more delicate dishes.

New Use of Electric Light.

In Berlin the use of glow-lamps attached to vehicles and the horses drawing them is now so common as to excite no remark. An adaptation of the glow-lamp for the latter purpose is shown in the cut herewith. The lamp is enclosed in a silvered reflector, and is fed from a small battery of accumulators carried on the vehicle. The wires are enclosed in small guttapercha tubes sewn to the harness and made exceedingly flexible. The battery consists of four or six plates, having a capacity of 20 ampere hours. It is conveniently carried under the coachman's seat. The illustration shows only one of the numerous adaptations of the electric light for this purpose; others may easily be imagined.



The Efficiency of Electric Heating.*

Experiments which have been made show that the efficiency of electric heating may counterbalance its intrinsic costliness. Masses of metal were heated, first by combustion methods and then by the electric current. The masses consisted of rods of platinum and iron; these when heated by a flame were dropped into water, and the temperature estimated from the rise in temperature of the mass of water. When the substance was heated by a flame the energy expended was calculated from the loss of weight of the combustible and the corresponding calorific power. When electrical energy was used the energy was calculated from the current and pressure. In the first series of experiments a platinum rod was heated in the flame of a spirit lamp and also by passing a current through it; when red-hot it was dropped into water. The results showed that less than 0.5 per cent. of the thermal energy in the flame was transferred to the bar, whereas 90 per cent. of the electrical energy appeared as heat. In the second series of trials an iron bar weighing a little over two pounds was heated first by means of well-dried charcoal, and then electrically. In the former case about 0.75 per cent. of the thermal energy was transferred to the bar, in the latter case 88 per cent. was accounted for. These results show that for some purposes electrical heating has claims to consideration.

At the time when the firm of Messrs. Goolden & Trotter was in existence the "dioptric" shades were introduced. These met with a hearty reception, but are not to be often met with nowadays. An electric light globe has recently been "invented" in France which appears from its description to be practically a modification of the dioptric glasses. Some measurements of the light absorption in dioptric glasses which we made years ago showed the loss was much lower than is usually supposed, while the benefit due to the more equable illumination more than balances the slight loss. In the French form of globe, or "holophane," the glass is made with vertical corrugations on the inside surface and horizontal corrugations on the outside surface, and these are formed of pressed glass. The corrugations must be, determined very carefully if internal reflection is to be avoided. For interior lighting the corrugations would be all similar, but for street lighting they are so proportioned that all points on a horizontal plane below the globe are uniformly illuminated up to an inclination of 15° below the horizontal, this being caused partially by a total reflection of the rays which originally pass above the horizon of the lamp. The loss by absorption with the corrugations properly designed does not exceed 9 to 13 per cent. With the use of this form of globe a slight iridescence of the light is caused, which gives it a peculiarly rich appearance, and this feature is of value in the use of arc lamps for interior lighting.

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* "Industries and Iron."

SOCIETY NEWS.

American Institute of Electrical Engineers.

At the 92d meeting of the Institute held at 12 West 31st street, December 19, a Paper was presented by Mr. Ludwig Gutmann, of Chicago, "On the Production of Rotary Magnetic Fields by a Single Alternating Current." In the absence of the author the Paper was read in abstract and the discussion opened by Dr. M. I. Pupin and continued by Messrs. Wolcott, Kennelly and Burnett.

A committee was appointed by council to consider the question of an index of electrical literature. The committee is as follows; Prof. F. B. Crocker, chairman; Messrs. Edward Caldwell and A. E. Kennelly, Professors W. M. Stine and Geo. B. Shepardson.

Another Practical Scheme for Popular Education.

The Edison Electric Light Co., of Philadelphia have thrown open their parlors for a course of thirteen lectures on practical electrical subjects, beginning December 7, and continuing one night a week till March 8 next.

The subjects and lectures are as follows:

"Introductory Remarks," Prof. Wm. D. Marks.

"Boilers of the Edison Electric Light Co. of Philadelphia," Thos. O. Organ.

"Machine Work and Machinery Erection," A. Falkenau.

"Steam Machinery and Piping," H. C. Phillippi.

"Incandescent Lamps and their Manufacture," John W. Howell.

"Electrical Distribution," Wm. C. L. Eglin.

"Boiler Feed Apparatus," Wm. M. Barr.

"Underground Conduits and Conductors," Jos. D. Israel.

"Heating of Wires," A. E. Kennelly.

"Electrical Meters," H. P. Edson.

"Dynamos and Motors," Montgomery Waddell.

"Finances of Electric Lighting," W. H. Johnson.

"History of The Edison Electric Light Co. of Philadelphia," Prof. W. D. Marks.

A new colliery, which is just being opened under American proprietary auspices, near Eckington, Derbyshire, Eng., will serve as a practical example of the utilization of electric energy of no small moment. Chandos Pole is the owner of the colliery, which is to be lit and worked entirely by electricity. High pressure boilers with high-speed steam engines will be put down with suitable dynamo and motor plant. The under-cutting of coal, which will be done entirely by electric coal-cutting machines of the later design, and the ventilating fans will be driven by separate motors of their own. The progress and results of this important installation will be watched with the greatest interest.

Magnetic Properties of Liquid Oxygen.

(Continued from page 280.)

The lecturer took a cup made of rock salt and put in it some liquid oxygen. The liquid did not wet rock salt, but remained in a spheroidal state. The cup and its contents were placed between and a little below the poles of an electro-magnet. Whenever the circuit was completed the liquid oxygen rose from the cup and connected the two poles. Then it boiled away, sometimes more on one pole than the other, and when the circuit was broken it fell off the pole in drops back into the cup. He also showed that the magnet would draw up liquid oxygen out of a tube. A test-tube containing liquid oxygen when placed in the Hughes balance produced no disturbing effect. The magnetic moment of liquid oxygen is about 1,000 when the magnetic moment of iron is taken as 1,000,000. On cooling, some bodies increased in magnetic power. Cotton wool, moistened with liquid oxygen, was strongly attracted by the magnet and the liquid oxygen was actually sucked out of it on to the poles. A crystal of ferrous sulphate, similarly cooled, stuck to one of the poles.

The lecturer remarked that fluorine is so much like oxygen in its properties that he ventured to predict that it will turn out to be a magnetic gas.

Nitrogen liquefies at a lower temperature than oxygen, and one would expect the oxygen to come down before the nitrogen when air is liquefied, as stated in some text books, but unfortunately it is not true. They liquefy together. In evaporating, however, the nitrogen boils off before the oxygen. He poured two or three ounces of liquid air into a test tube, and a smouldering splinter of wood dipped into the mouth of the tube was not re-ignited; the bulk of the nitrogen was nearly five minutes in boiling off, after which a smouldering splinter dipped into the mouth of the test tube burst into flame.

Between the poles of the magnet all the liquefied air went to the poles; there was no separation of the oxygen and nitrogen. Liquid air has the same high insulating power as liquid oxygen. The phenomena presented by liquefied gases present an unlimited field for investigation. At —200° C. the molecules of oxygen had only one-half of their ordinary velocity and had lost three-fourths of their energy. At such low temperatures they seemed to be drawing near what might be called the "death of matter," so far as chemical action was concerned; liquid oxygen, for instance, had no action upon a piece of phosphorus and potassium or sodium dropped into it; and once he thought, and publicly stated, that at such temperatures all chemical action ceased. That statement required some qualification, because a photographic plate placed in liquid oxygen could be acted upon by radiant energy, and at a temperature of —200° C. was still sensitive to light.

Prof. McKendrick had tried the effect of these low temperatures upon the spores of microbic organisms, by submitting in sealed glass tubes blood, milk, flesh, and such like substances, for one hour to a temperature of 182° C., and subsequently keeping them at blood heat for some days. The tubes on being opened were all putrid. Seeds also withstood the action of a similar amount of cold.

MR. J. W. GODFREY AND THE WIRE TRADE.

As previously announced in these columns, Mr. J. W. Godfrey, for eight years connected with the New York Insulated Wire Company as general manager, has resigned that position to take charge of the selling department of the India Rubber and Gutta Percha Insulating Company Room 38, No. 15 Cortlandt street, New York, whose Habirshaw Wires are known the world over. Mr. Godfrey is one of the best known and most popular men connected with the wire trade, and his name and word have become synonymous with all that is good and fair in the business. His untiring energy and reputation have done wonders for the New York Insulated Wire Company and its products, and it is easy to predict the same for his influence in his new connections. A first-class article handled by a first-class man is all that the trade can desire. The congratulations of ELECTRICITY are therefore offered to the India Rubber and Gutta Percha Insulating Company, to the trade, and to Mr. Godfrey and his able assistants, Messrs. F. W. Harrington and J. B. Olsen.

LEGAL NOTES.

An attachment has been issued against Neftel, O'Connor & Co. (corporation), electrical contractors at 126 Liberty street, for $11,704, in favor of Bernard F. O'Connor, the treasurer, for salary and money loaned to the concern. The sheriff took possession of a lot of stocks and bonds which belonged to the attached concern. The company was incorporated in May, 1892, with a capital stock of $50,000, and constructed electric light plants at several places. Knight Neftel was president.

The suit of Edward B. Hess to recover $50,000 from the Thomson-Houston Electric Company for commissions has been dismissed by Justice Williams of New York. Hess alleged that in 1890 the company agreed to pay him a commission of 5 per cent. of the price of apparatus purchased from the company by surface roads above Harlem Bridge. He declared that he induced the "Huckleberry" Railroad to adopt the Thomson-Houston system.

The litigation which has been occupying the attention of the courts since the Bankers and Merchants' Telegraph Company was placed in the hands of Receiver John G. Farnsworth and its purchase in foreclosure proceedings by Edward S. Stokes for $500,000, on July 31, 1885, has practically come to an end by the entry of an order by Judge Lawrence, of the New York Supreme Court, stating that the purchase price has been fully paid, and that Edward S. Stokes and the United Lines Telegraph Company are fully discharged from further liability and the receivership terminated.

In its answer to the bills in equity in the suit brought by the Edison Electric Light Company against the Terminal Railroad Association for alleged infringement of patents used in the electrical installation of the new Union Station at St. Louis, the defendant company denies that Thomas A. Edison was the true, original and first inventor of an improvement in electrical distribution and translating systems because he made his application for patent August 9, 1880, while others had precedence. Further, that it is not established in the bill of equity by the plaintiff that Thomas A. Edison assigned his alleged patents to the Edison Electric Company, but the defendant admits that letters patent No. 264,642 were issued to Edison Electric Company September 19, 1882, but deny that it was in due form of law and deny that it was for seventeen years. The defendant further denies that Edison made proper application for patent on December 9, 1881, and it is not proven that Edison assigned such patent to the Edison Electric Company. The plaintiff further admits that patent No. 266,793 was issued to Thomas A. Edison October 31, 1882, but deny that it was in true form of law, and claim no knowledge save by the plaintiff's bill that the Edison Electric Light Company was or is a corporation. The gist of the whole matter is the broad claim by the defence that all of Edison's patents are null and void because Edison was not the true inventor of such electrical appliances as are in dispute in this suit.

The Wenstrom Patents.

The Fort Wayne Electric Corporation will bring suit at once to test the validity of the Wenstrom patents. There are a large number of these patents, but the one which is being infringed the most is the Wenstrom armature patent. Several of the largest electric companies in the country are alleged to be guilty of this infringement.

Mr. R. T. McDonald, the president of the company, declines to make public at present the names of the companies who are infringing these patents. As soon as the first of these suits is entered he promises to divulge some of the inside workings of the infringements which would prove quite startling.

A correspondent of the *Sun* has supplied that paper with the information that Mr. Edison has on his front door an electric bell which does not work.

New England Notes.

Since the order passed some time ago by the Board of Aldermen went into operation in Boston the West End Railroad Company has laid 200,000 feet of conduit, the Boston Electric Light Company 90,000 feet and the Telephone Company 15,000 feet. The men are now busy running the wires through these conduits. Of the 7,000,000 feet of overhead wires to be removed in one district alone fully one-half of them are abandoned or dead wires.

The Fall River Board of Aldermen have refused to grant the petition of the Fall River and Taunton Street Railway Company, asking permission to build a road through certain streets of the first named city to Somerset. This decision is a victory for the Rochester syndicate, which controls the Globe Street Railway system.

The marvelous extension of electric railway systems in all parts of New England, combined with the popular use of the bicycle, is credited with being the cause of the present depression in the horse trade which prevails everywhere. The breeding of horses is in a fair way to become one of the lost arts.

The business men of Lewiston and Auburn, Me., promptly appreciating the value of Judge Carpenter's decision in the Berliner patent suit, have already taken steps looking to the establishment of a telephone exchange in their towns, the same to be run on the co-operative plan. They are tired of paying the extortionate rates they have so long been charged, and by the establishment of a local exchange they believe they will secure better service and cheaper rates.

The troubles of the Braintree and Weymouth Street Railway Company are not yet at an end. They have had pretty hard luck in getting to where they now are, which is within seeing distance of the end of constructing their new road. They have just laid a grade crossing over the tracks of the New York, New Haven and Hartford Railway Company in East Braintree, and when their employees had only another half hour's work to do ere they completed the job, an injunction was served upon them to desist. They went ahead, however, and finished, and next Wednesday the courts will take a hand in settling the dispute.

The Thompson Brown Electric Company of 97 High street, Boston, is manufacturing and selling in enormous quantities a new metal polish for use on all kinds of bright metal as well as on carbon rods. Although it has only been on the market a short time this specialty is meeting with an extraordinary demand and is now in use in nearly every electric light and power station in the country. This new electric supply house, though established but a few months, are already doing a large business. They are about to place on the market in a few weeks an entirely new line of railway devices.

General News.

What is Going on in the Electrical World.

Lockport, N. Y.—The Citizens' Mutual Telephone Company have asked for a franchise to operate in this city.

South Haven, Mich.—A public vote is to be taken at once on the question of issuing bonds for an $8,000 electric light plant.

Shawano, Wis.—The council has resolved to install electric lights and awaits proposals from parties competent to put in the plant.

Osawatomie, Kan.—The electric light power house and plant were destroyed by fire on the 11th inst. The plant was valued at $5,000.

Calais, Me.—The St. Croix Gas Company will soon put in an incandescent electric light plant to supply Calais, St. Stephen, and the two Milltowns.

Athens, Ga.—There is a movement on foot here to utilize the water power at Tallesse Shoals in generating electricity for transmission to this city; 1,300 horse power is available.

Detroit, Mich.—The Detroit Electric Lighter Company has filed articles of association with the county clerk. The capital stock is $50,000. The "electric lighter" is a cigar lighter.

Carthage, Mo.—The Jasper County Electrical Railway Company has purchased forty acres of land between this city and Carterville, on Center creek, for park and power house purposes.

Oskaloosa, Iowa.—The electric light plant of this city has been badly damaged by fire. Two dynamos and two engines were among the property destroyed. The total loss is about $25,000.

Delavan, N. Y.—This little Cattaraugus town of 500 inhabitants has voted to light its streets with electricity. It is probably the smallest town in the country indulging in such a luxury.

Rockville, Conn.—A company has been organized and the capital secured to build an electric road from Rockville to Stafford Springs as soon as the Hartford road is completed to this city.

Portsmouth, N. H.—The board of aldermen has accepted the report of the committee on electric lighting recommending that an election be held to decide whether the city shall own and operate an electric lighting plant.

Rutherford, N. J.—The Union Traction Company has mortgaged its real, personal and other property to the Metropolitan Trust Company of New York for a million dollars, payable in 1924. The interest is five per cent.

Nevada, Mo.—The Missouri and Kansas Electric Company have begun to build their line from Joplin to Pittsburg, via Fort Scott, to Nevada, and then direct to Kansas City, taking in a number of thriving towns on the line.

Saginaw, Mich.—The Union Street Railway Company has commenced transferring its recent purchase, the old horse-car line, into an electric line. The company will erect a new power-house and calculate to expend over $100,000 in improvements.

Atchison, Kan.—The Brush Electric Company has sued the Atchison Street Railway and Lighting Company for $5,000. The claim is for supplies alleged to have been furnished to complete the plant. The claim is disputed by the Atchison Company.

Hollidaysburg, Pa.—The Robinson Machine Works of Bellwood, this county, have been sold at receiver's sale to an Altoona syndicate. The works will be enlarged and will give employment to a large force of men in the manufacturing of electric machinery.

Vicksburg, Miss.—The plant, lines, etc., of the Vicksburg Railway, Power and Light Company have been sold to satisfy a deed of trust for $17,000 held by R. T. Wilson & Co., of New York. They were bought in by a representative of this firm for $10,000.

San Diego, Cal.—A contract has been entered into between the San Diego Electric Railroad Company and the Hoskins Traction Company of San Francisco for the equipment of the mule line, which forms a part of the local street car system, with the Hoskins electro-vapor system.

Terre Haute, Ind.—The city council has granted the People's Electric Railway Company a franchise to construct and operate a street railway in Terre Haute, but the Terre Haute Electric Railway Company, which has a line in operation, will contest the use of the streets by the new company.

Central Lake, Mich.—This village is anxious to have electric light, and two manufactories in the place are willing to put in a plant as soon as they can be legally granted a franchise. To grant this, the village must be incorporated, and the Legislature will be asked this winter for permission to incorporate.

Cicero, Ill.—The town board of trustees has granted the Ogden Street Railroad Company the right to establish and operate street car lines on various streets of this town. The power used will be the overhead trolley system. The estimated cost of the construction of the road and the necessary rolling stock is $1,000,000.

North Tonawanda, N. Y.—In the spring the Cataract Electric Company intend to have a trolley system constructed from Niagara Falls to North Tonawanda, with which to test the various methods of propulsion. All inventors of propelling machinery are to be invited to be present with their appliances. This road is now very near completion.

Camden, N. J.—A mortgage for $450,000 has been filed in the office of the Register of Deeds in Camden. The mortgage is held by the Old Colony Trust Company of Boston, Mass., and was given by the Electric Storage Battery Company of Gloucester City, and embraces 450 bonds of $1,000 each, which cover about 200 patents on electric batteries.

Attleboro, Mass.—The Attleboro, North Attleboro and Wrentham Street Railroad has been sold at auction; it was bid in by Edwin R. Pierce of North Attleboro for $51,000. Mr. Pierce represented a syndicate of business men of Attleboro, North Attleboro and Pawtucket. This sale is only of the Wrentham line and does not affect the Interstate.

Albany, N. Y.—At the meeting of the common council on the 17th, a resolution was presented and referred instructing the Committee on Application to the Legislature to inquire and report on the feasibility of the city furnishing its own electric and gas lighting. The city now pays to the Electric Illuminating Company over $90,000 a year for the street lights.

Jersey City, N. J.—The Consolidated Traction Company is building another electric line between this city and Newark, forming a belt railway. The old line crosses the Communipaw avenue bridge, and the other line will extend over the West Newark avenue bridge. Cars going westward via Communipaw avenue will return eastward by way of West Newark avenue, and vice versa.

Natchez, Miss.—The Natchez Electric Railway Company, a newly organized corporation, is arranging for the immediate building of its line in the streets of this city. The capital stock of the company is $100,000 with the privilege of increasing it to $250,000. The corporators are Rufus F. Learned, W. A. S. Wheeler, A. W. Swanitz, C. B. Beasom, Frank J. Arrighi and James A. Clinton.

Savannah, Ga.—The Electric Railway Company has increased the fare on one of its lines from 1 to 2 cents, and on another from 1 to 5 cents. The reason for the increase given is that the regular patrons of the lines demanded it on account of the inconvenience suffered by the overcrowded condition of the cars at the 1 cent fare. Fares on the other lines throughout the city continue at 1 cent.

Fort Wayne, Ind.—Electricity will form a special feature of the Fort Wayne Gas Company, recently organized here. The company is founded for furnishing natural and artificial gas, petroleum and electric and other agencies for producing light and heat. The capital stock is $2,000,000 and headquarters will be at Fort Wayne. This syndicate now controls all the gas fields that heat and light Fort Wayne.

Uniontown, Pa.—The prospective development of coal lands in Washington county is urging forward the proposed electric railroad from Brownsville down the Monongahela river through California, Charleroi and the innumerable mining towns skirting that stream, which will compete with the Pittsburg, Virginia and Charleston Railroad and the steamboat lines for passenger traffic. The projectors are developing greater plans than this for the region.

West Chester, Pa.—The *News* of the 18th inst. says: "Robert M. Simons yesterday went to Philadelphia to visit a young inventor who has a device for running cars without trolley or storage battery, the current being communicated through a metallic strip along the ground between the tracks. Mr. Simons, after making a careful examination of the scheme, came home a convert to the system, and he will advocate the adoption of it on a Kansas road in which he is interested."

Brooklyn, N. Y.—The president of the Electrical Subway Commission, Prof. George W. Plympton, reports that the total length of electrical conductors of all kinds within the city limits at the present time is 15,840 miles, of which there is either in conduits underground or suspended to elevated roads a length of 9,380 miles; on poles and housetops, 6,460 miles, about 870 miles of which belong to the fire and police departments; amount buried during the year, 1,960 miles.

Columbus, Ohio.—Martin Dodge, of Cleveland, formerly president of the Ohio Road Commission, has in his mind a project for gridironing the State with electric roads. He thinks the time is ripe for an act under which the State and the counties may join hands, and construct electric roads between all the county seats in the

State; the lines to be operated by private enterprise on lease after they have been built. He would have the counties pay half the expense of the immense work and the State the remainder. He estimates that this would require 4,000 miles of road and would cost over $20,000,000.

Oshkosh, Wis.—J. K. Tillotson reports that articles of incorporation are being drawn up for the Wisconsin Interurban Street Railway Company, whose capital stock is $1,000,000. The following are the directors of the company, as given by Mr. Tillotson: George H. Ketcham Toledo, O.; George J. Kobusch, secretary, treasurer and general manager of the St. Louis Car Company, St. Louis; Otto Van Schrader, secretary, treasurer and general manager of the Rankin & Fritch Foundry and Machine Company of St. Louis; Chas. E. Loss of C. E. Loss & Company, contractors, Chicago, Ill.; Worman McCarty of the Westinghouse Electric Company, Toledo, O.; F. M. Ohl, Toledo, and W. C. Gotshall, St. Louis.

Wappingers Falls, N. Y.—On the completion of the electric railway connecting this village with Poughkeepsie, on the 16th inst., the citizens tendered a reception and banquet to James W. Hinkley, president of the Poughkeepsie and Wappingers Falls Electric Railway, who was the leading spirit in the enterprise. About 150 of the prominent citizens of Poughkeepsie and the Falls were present, and after the banquet the large list of toasts brought out the happiest efforts of those who were called upon to speak. Each toast on the list was supplemented by appropriate lines from the poets, those affixed to "Our Merchants" being: "Really if a man won't let us know that he's living, he's dead, or should be so."

Los Angeles, Cal.—The *Express* states that the long talked of electric railroad between Los Angeles and Santa Monica is rapidly approaching the point of materialization. In brief, the plan is the utilization of the old Los Angeles and Pacific Railroad by a corporation to be formed, which is understood to be practically the same as the Los Angeles Consolidated Company. A contract of sale has been signed by the owners of the old Los Angeles and Pacific, whereby on certain terms they transfer all the property to Mr. Stevens, a well-known capitalist of San Francisco, who is operating in behalf of the Los Angeles and Pasadena Electric Railway Company, which is part of the Consolidated, the object being to make a continuous line through this city from the mountains to the sea.

New York.—A test was made at the residence of the inventor in this city, on the 19th inst., in the presence of a number of newspaper men and capitalists, of a new telephone system. The test was made over a wire in resistance equal to 3,000 miles of line wire, and the result was considered by all who were present eminently satisfactory. It is said that this telephone has been made to speak over an ordinary telegraph line 230 miles in length, and that by means of it conversation can be carried on at a distance of thousands of miles without repeaters. It is claimed that the Bell instrument cannot be made to speak over a telegraph wire, but requires for the production of the voice specially prepared and costly wires, known as a metallic circuit. The new system is the invention of Dr. William Marshall, and is entirely novel in construction and principle.

Chicago.—The electric road now being constructed on West Monroe street is exciting curiosity. The franchise prevents the company from using the overhead trolley system; an underground conduit is not in the plan, and the builders will not tell what system is to be used. The presumption is that some new form of storage battery is to furnish the motive power.—At a meeting in this city of the creditors of Elmer D. Roberts, of Racine, Wis., a proposition to pay 50 cents on the dollar, submitted by Mr. Roberts, was accepted. The creditors represented were: The New York Insulated Wire Company. Metropolitan Electric Company the Central Electric Company, the Buckeye Lamp Company, the American Reflector Light Company, Williams & Schreader, and Kohler Bros., all of Chicago, and the First National Bank, the Commercial Bank, and Racine Hotel, of Racine, Wis.

Boston, Mass.—The *Traveller* states that "the director of the Museum of Fine Arts has received from N. S. Amstutz, Cleveland, Ohio, a specimen of work done by means of his marvelous new invention, the transmission of an engraving by telegraph. A process reproduction of a photograph of a man is shown on one page of a small sheet, and on the opposite page is the same portrait after it was sent by telegraph The copy is sufficiently like the original engraving to be recognized as a portrait of the same person, although it is misty. The two portraits may by a little poetic license be said to resemble each other as the mist resembles the rain. The secret of Mr. Amstutz's invention is, of course, not revealed, but it is claimed that it is very simple and not expensive, and that almost any telegraph office can do the work without costly extra equipment."—The State Gas Commission has cut down the amount of bonds which the Boston Electric Light Company wants to issue. The company proposed $900,000, but the commission approves only $600,000, to be issued under restrictions.

Lalanche Porous Cup.

The Central Electric Company have placed on the market a Lalanche Porous Cup, having the date on which it was made stamped on the outside. Every one using these will appreciate this as it is frequently a great convenience to be able to determine why a cell fails or to know that it has failed much sooner than it should under ordinary circumstances. Knowing the date of its manufacture, it is an easy matter to determine whether the difficulty rests with the Porous Cup itself The Central Electric Company are sending out the supplements to their large catalogue. This gives over 100 pages of new and additional Electric Appliances. The most cursory examination reveals the evidence of careful selection and discrimination in adding new material to their already extensive line. The Central Electric Company's address is 173-175 Adams street, Chicago.

Partridge Motor Brushes.

The Partridge Carbon Company, Sandusky, O., whose specialty is High-Grade Motor Brushes, report a splendid improvement in trade all along the line. Their brushes are now in use on nearly every one of the best railway systems of the country, and the satisfaction is such that wherever introduced an increased trade follows.

Dixon's Pencils.

The editor acknowledges with full appreciation the customary Christmas reminder of a box of assorted pencils from the Jos. Dixon Crucible Company. They are of a high quality, and the toughness of the leads prevents much profanity in the sanctum.

INCORPORATIONS.

A company has been incorporated under the general incorporation act of Maryland to construct an electric railway from Reistertown to Union Mills, Carroll County, Md. The road is intended to be a link in the lines extending from Baltimore to Gettysburg and will be nineteen miles long. Capital stock, $250,000. Directors: T. Herbert Shriver, of Union Mills; Gov. Frank Brown, George R. Webb, of Baltimore; Charles E. Stewart, Wm. B. Thomas, George W. Albaugh, John L. Reifsnider, Edwin J. Lawyer and Charles C. Gorsuch, of Westminster, Md.

The Susquehanna River Electric Company of Baltimore City, Baltimore, Md.—to transact a general business in electrical appliances, merchandise, lands, etc. Capital stock, $100,000. Incorporators: Moses H. Houseman, Geo. K. McGaw, Winfield J. Taylor, of Baltimore, and Charles R. McConkey, of Peach Bottom, Pa.

The Mutual Electric Light Company, San Francisco, Cal.—to generate, transmit and sell electric light, heat and power; manufacture and deal in telephones and do a telephone business. Capital stock, $500,000. Promoters Thos. R. Henshelwood, John B. Halsed, Cyrus C. Dow, San Francisco.

The Keosauqua Canal and Water Power Company, Keosauqua, Iowa—to erect and utilize a water power and generate electricity or compressed air. Promoters: Ben Johnson, W M. McIntosh, H. E. Duckworth, C. W. Casner, Jas. Anthony, Keosauqua.

The Phœnix Electric Supply Company, Warren and Youngstown, Ohio—to deal in electrical supplies of all kinds, manufacture electric lamps, supply electric light and power, etc. Capital stock, $1,000. Promoters: Warren B. Swager, Warren L. Swager, Wm. F. Corbin, Herbert M. Miller, David W. Campbell.

Castle Rock Electric Company, Castle Rock, Wash.—to operate electric light and power plant. Capital stock, $1,000. Promoters: C. E. Forsyth, A. S. Forsyth, H. V. Gates.

The Valparaiso Gas and Electric Company; Valparaiso, Ind.—Supplying gas and electric light. Capital stock, $120,000. Promoters: Jesse Scribner, Otis E. Turner, Oscar H. Olsen.

The Deal Lake, Asbury Park and Ocean Grove Transit Company, Asbury Park, N. J.—to build, equip and operate a railway for the transportation of passengers and freight in Neptune and Ocean townships, New Jersey, which embrace Long Branch, West End, Elberon, Darlington, Loch Arbor, Interlaken, Asbury Park, Ocean Grove, Bradley Beach and Avon-by-the-Sea. The road is to be operated by the trolley system. Capital stock, $150,000. Incorporators: Halsey M. Bennett, of Bloomfield, N. J.; William E. Cottrell, of Newport News, Va.; R. Ten Broeck Stout, Joseph C. W. Stout, Wesley B. Stout, of Asbury Park, and others.

Empire Light and Power Company, at Quincy, Ill. Capital stock, $25,000. Incorporators: Isaac L. Faucett, Harry O. Chandler and John B. Wheeler.

The Delany Heater and Rheostat Company at Newark, N. J.—to manufacture and sell rheostats and electric heating apparatus in South Orange and New York City. Capital stock, $100,000. Incorporators: Roderick Robertson, of East Orange, N. J., and Frank W. Tappan, John C. Tomlinson, Edward T. Birdsall and Ezra T. Gilliland, of New York.

Articles of consolidation have been filed at Albany, of the Susquehanna Electric Traction Company with the Waverly, Sayre and Athens Electric Traction Company, forming the Waverly, Sayre and Athens Traction Company. Capital stock, $200,000. Directors: S. B. Broadhead, of Jamestown, N. Y.; F. K. Harris and A. C. Robertson, of Athens, Penn., and William L. Watrous and Michael Quigley, of Waverly.

The Corning Traction Company, Corning, N. Y.—to construct a street surface electric road between Corning and Painted Post. Capital stock, $40,000. Directors: Fred. E. Lyford, Percy L. Langf, Clay Clapp and Frederick E. Hawkes, of Waverly, Tioga County; D. N. Johnson, of Ithaca; Nathaniel C. Harris, F.K. Harris, Charles Kellogg, and A. C. Robertson, of Athens.

The White Hall Electric Company, White Hall, Ill.—to furnish electric lights and electricity to propel machinery. Capital stock, $10,000. Promoters: Gilbert S. Vosseller, Orlando F. Griswold, Henry W. Hand.

Woven Wire Brushes.

The Belknap Motor Company of Portland, Me., are the patentees and manufacturers of the best Woven Wire Brush on the market.—[*Adv.*

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED DECEMBER 18, 1894.

ELECTRIC RAILROADS AND APPLIANCES.

530,956. Hand Operating Mechanism for Electric Locomotives. Andrew W. Mitchell, Boston, Mass. Filed April 14, 1892.

530,954. Trolley-Wire Finder. Frederick F. Meyer and William S Meyer, Newark, N. J. Filed March 14, 1894.

531,052. Controller-Handle. Henry Mittelsdorf, Orange, N. J. Filed Aug. 29, 1894.

531,151. Trolley-Track. William H. Brodie, Brooklyn, N.Y. Filed Oct. 4, 1894.

531,268. Brake and Power Controller for Electric Cars. Andrew W. Mitchell, Boston, Mass. Filed Jan. 22, 1894.

531,291. Guide for Trolley-Wheels. William H. Dickerhoof, Cincinnati, Ohio, assignor of one-half to Geo. W. Pollock, same place. Filed July 23, 1894.

ELECTRIC LIGHTS AND APPLIANCES.

531,146. Signal-Lamp for Electric-Railway Cars. Charles H. Baker, Detroit, Mich. Filed April 24, 1894.

531,159. Spark-Arrester for Arc Lamps. Edwin M. Clark, Detroit, Mich. Filed April 24, 1894.

531,288. Incandescent-Electric-Lamp Socket. Charles H. Balsley, Connelsville, Pa., assignor of one-fourth to G. W. Bryner, same place. Filed April 20, 1894.

TELEPHONE AND TELEGRAPH APPARATUS.

530,957. Finger-Board Telegraph-Key. Elmer E. Mullinix, Burlington, Kans. Filed July 31, 1894.

531,078. Telephone Speaking-Tube System. Thomas C. Wales, Jr., Boston, Mass., assignor to the American Bell Telephone Company, same place. Filed April 7, 1894.

531,194. Telephone-Transmitter. David A. Kusel, St. Louis, Mo. Filed Aug. 6, 1894.

SIGNALING AND ALARM DEVICES.

530,975. Circuit-Closer for Burglar-Alarm Systems. Alfred Stromberg, Chicago, Ill. Filed May 24, 1894.

530,976. Burglar-Alarm System. Alfred Stromberg, Chicago, Ill. Filed May 24, 1894.

531,284. Electric Block-Signaling System. Adoniram J. Wilson, Port Chester, N. Y., assignor to the Hall Signal Company, of Maine. Filed May 14, 1894.

MEASURING INSTRUMENTS.

531,006. Dynamometer. Rolf J. Rolfson, San Francisco, Cal. Filed Oct. 4, 1893.

531,153. Electric Meter. Theodore Bruger, Bockenheim, near Frankfort-on-the-Main. Germany, assignor to Hartmann & Braun, same place. Filed June 22, 1894.

MISCELLANEOUS.

530,951. Electric Conduit. Thomas T. La Pointe, James H. Flanagan and Charles A. Thompson, New Haven, Conn. Filed Nov. 23, 1893.

531,002. Electric Program Clock. John L. McCaskey, Waynesborough, Pa., assignor to Frederick Frick. Filed Sept. 13, 1893.

531,005. Electric Converter. Frank C. Priestly, San Francisco, Cal. Filed Feb. 16, 1894.

531,109. Electric Belt. Louis F. Fuller and Andrew J. Taylor, Norfolk, Va. Filed Aug. 8, 1894.

531,130. Electrical Switch Setting and Locking Device. Karl Moderegger, Vienna, Austria-Hungary, assignor to Siemens & Halske, Berlin, Germany. Filed Feb. 8, 1893.

531,143. Apparatus for Electric Heating, Smelting and Separating. Joseph W. Woodfolk and John C. Wharton, Nashville, Tenn. Filed Dec. 12, 1893.

531,214. Electric Safety Appliance for Railroads. Edward L. Orcutt, Somerville, Mass. Filed Nov. 2, 1893.

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N. E. L. A.—The next annual meeting of the National Electric Light Association will be held at Cleveland, O., February 19-21, 1895. Every concern interested in either lighting or railway work should be represented in the membership of this body, and should have at least one representative at the Cleveland meeting. The Secretary is Mr. Geo. F. Porter, 136 Liberty street, New York.

EDITORIAL NOTES.

General Electric. The closing days of 1894 were marked by a renewal of gossip concerning the G. E. Company, its present condition and future prospects. Common sense is absent from most of the comments of the daily press, of the financial reports and of the speculators.

Notwithstanding the disastrous career of the company, the proven falsity of all the official statements given out since June, 1892, the mysterious influence of the names of the directorate seems to be almost as powerful as ever and the public are overawed. This influence applies as well to the daily papers, which seem utterly afraid to look into the affairs of the organization and print the facts.

If a similar business had been conducted by men of only ordinary standing in the community there would have been such a searching investigation into the cause of the collapse and the robbing of the public of millions of money that New York would not have been a comfortable place for the responsible parties to live in.

The stockholders themselves seem afraid to make any protest, holding perhaps that it is indeed an honor to be humbugged by the "Finest Board of Directors in America."

Notwithstanding all reports to the contrary, the affairs of this concern have not improved one iota since January 1, 1894. The improvement claimed is a delusion and does not rest on a basis of fact.

It is undoubtedly true that the debts, so far as they ever were allowed to appear on the books, are practically wiped out; there is probably $1,500,000 to $2,000,000 of bills payable, however, instead of the $300,000 claimed on January 31, 1894. If the company is doing the business claimed, and paying on a sixty-day basis, it is about $2,000,000.

It is also true that about $1,000,000 of bonds have been retired during the year; it is also true, on the other hand, that the cumulative interest on the preferred stock is piling up a debt at the rate of $300,000 a year.

But admitting that the debts are paid, that bonds have been retired, how has it been done? From profits in the business? Certainly not. They have sold during the year a large amount of local securities, have cleaned up a number of bad accounts, and with the proceeds from these two sources they have reduced their debts and retired some bonds?

What will they do when their treasury assets are all sold.

From the standpoint of the commercial creditors of the concern there is nothing to fear. But how about the stockholders?

ELECTRICITY has devoted considerable attention to this subject for the past month, and we are convinced that the reports given out from week to week are no nearer correct than those which have preceded them—all proved to be false.

If the stockholders had taken possession of their property eighteen months ago, thrown out the present management, elected capable business men, there would have been some chance for the establishment of a profitable business. The longer the present ring are left in control, the fewer the chances become for the accomplishment of any such result. There has been nothing but mismanagement from start to finish, and that mismanagement is more conspicuous to-day than ever.

Changes in the situation, changes in the personnel of the organization, have made a great deal of information available which could not be gathered accurately six months ago.

There is no doubt that a thorough reorganization of the company is now at hand, entailing either an assessment of common stockholders or the wiping out of the stock. This is the opinion of the best-informed men both in Boston and New York.

The next annual report will show an added charge to profit and loss of about $6,500,000, making nearly $19,000,000 all told. This will be the official estimate. It will be proved, when the stockholders make their intended investigation into affairs, to be entirely too small. And it may be stated now as a predestined fact, that the next report will be no more reliable than No. 1 or No. 2.

If the first had been correct, it would have shown that no cash profits had ever been made, and that the payment of dividends was in defiance of law. ELECTRICITY will be very much surprised if the honorable board of directors are not yet compelled to reimburse many investors because of the liability incurred in permitting the payment of unearned dividends.

Our statements are based upon the opinions of men long connected with the company, knowing every detail of its methods of financiering and bookkeeping, familiar with the quality of all its remarkable assets.

A searching investigation of affairs by the stockholders is necessary. If they would recover any part of their investment, they must replace the present incompetent or dishonest management and put in charge men who will conduct the company as a legitimate manufacturing enterprise instead of as an annex to the stock market.

Whether any successful reorganization can be brought about without radical legal steps is a matter of grave doubt.

The management of the company has been worse than incompetent.

The interests of the common stockholders of the company have been ignored, their rights trampled under foot; the sole apparent aim of the directors is to prolong the life of the company for the sake of further opportunities for stock market speculation.

The only reasonable explanation to-day for postponing a confession of absolute failure is that the insiders are making money for themselves out of speculation in the stock, and that they desire to prolong their opportunities as long as the stockholders will submit.

Every one of the leaders has made money. We make this charge with knowledge, and we defy Drexel, Morgan & Co., C. H. Coster and Charles A. Coffin to produce their records of transactions in G. E. stock and disprove it if possible.

The entire career of the company has been marked with methods of dishonor and deception. With eleven months of the fiscal year ended, with the certainty that the next report will be but one more disappointment to stockholders, one more slap in the face to a confiding public, the officers are filling the financial columns with rosy tales of huge business and great profits, when as a matter of fact it is known that the company is making no money, that prices are one-half what they were two years ago, and that while selling expenses have been reduced, the reduction in prices has been more than enough to overbalance the entire charge for selling expenses.

Among all the rot given out last week, nothing was sillier than the claim of a "price arrangement" with the Westinghouse Company which would allow of a profit.

No arrangement of this kind could be made between the G. E. Company and any one of its competitors. The record of the former is such as to make it certain that it would not be lived up to one week. The days for bunco games of this nature have gone by forever. The independent electrical concerns have no further trades to make with the infamous organization which has cast discredit upon the entire range of electrical investments, disrupted the trade, and proved itself unworthy of any confidence.

The company is despised by its competitors, —boycotted by thousands of purchasers. The reason is not hard to find. It is found in the bulldozing methods which have characterized the sham Trust from the beginning. These methods are well known. The following example, which is authentic, will show, we think, to even a lay reader, just why it is that there has been no mourning for the G. E. Company's collapse in the electrical trade.

At the time of the G. E. consolidation the Denver Consolidated Company was buying everything from the G. E. Company, its purchases amounting to several thousand dollars monthly. The company was prosperous and had declined several overtures to mix itself up in financial deals with the Eastern people. Soon after coming to New York, Mr. Coffin called one of his agents into his private office and said to him :

> "You are pretty well acquainted at Denver, and we want some special work done there. You remember a few years ago we decided to start a small opposition company there, and they finally bought us out. We made a handsome profit. Now the Denver Consolidated Company has a capital of $1,000,000 and we must have some of it; it is good stock and pays 10 per cent. annually. We think you ought to go to your friends there and organize a new company. The Consolidated people would probably prefer not to be hostile to us and might give us about $250,000 of that stock. You see, I know all of Mr. Rawlins's (president of the Denver Company) financial friends in the East, and might have some influence on them in future deals of his if he chose to be unreasonable. Now, you go out to Denver and scorch them at that end and I will burn them up at this end."

The methods of the highwayman are rarely successful when applied to commercial business.

Whatever may be said to the contrary, ELECTRICITY speaks with full information in asserting that--

The stockholders would have got more money for their holdings if the company had gone into liquidation in August, 1893, before the treasury was gutted, than they can now.

That they can recover more to day than they can six months from to-day.

That the entanglements of the concern with such subsidiary companies as the bankrupt Northwest General Electric can never be unravelled except by the courts.

That a thorough investigation will show that contingent liabilities of over $3,000,000 have never been referred to in the official reports, and that some of them will become pressing liabilities before April 10 next.

Such an investigation would also show that, if valued by the best informed men in the electrical manufacturing and financiering lines, the assets of the company, as given in the last annual report, would be reduced by $20,000,000.

The unfortunate and humiliating collapse proves beyond the possibility of dispute that ELECTRICITY has been RIGHT in its contentions since August, 1892, that the attempt to form a Trust in the electrical trade would result in total failure, in loss to every investor who put money into the scheme.

We have few mistakes to confess, no apologies to offer.

ELECTRICITY has been *right*, and the General Electric Company has been wrong.

* * *

Those Troublesome Symbols.

In view of the discussions which have recently occupied so much of the space of one of our contemporaries on the question of symbols, the following editorial from *Electric Power* is particularly pertinent:

> It seems as if electrical readers would have become tired out by this time by the large amount of writing and talk that has been going on in reference to the use of the new symbols introduced by Prof. Hospitalier. We should hesitate about again entering on this subject if it were not for one of these units which has recently caused us personal anxiety. On reading over the article on Reactance, by Messrs. Steinmetz and Bedell, at the May meeting of the Institute, we discovered a somewhat promiscuous use of the letter "*I*," which in the new system takes the place of "*C*," meaning current intensity. The formula for reactance is variously given as equal to $\omega L - \dfrac{1}{C\ \omega}$; $\omega L - \dfrac{I}{C\ \omega}$, etc. Of course the first of these equations is the correct one, but probably owing to the fact that some of the "*I*" type had a corner lopped off, it was difficult to distinguish in the proof whether it was meant for the letter "*I*" or the figure "1." These proofs are always very carefully revised by the secretary of the Institute, are read one or more times by the authors themselves, and are sometimes given for criticism and correction to men who are especially fitted for such work. In spite of this fact two of these incorrect equations have gotten into the Institute *Transactions*, and if something is not done to head off the advance, there is no telling how much profanity may be provoked by readers who take interest enough to study them out. On page 773 of the November issue of the *Transactions* occurs the equation $K = \omega L - \dfrac{I}{C\ \omega}$ and on page 774 the same one is again used. Now the whole trouble in this article seems to have been caused by the change in using "*I*" in place of "*C*" for the intensity of current, and we submit, if one is going to run the danger of having the equations all twisted up by not being able to tell the difference between the letter "*I*" and the figure "1" in proof, is it not better to stick to the usage of "*C*" for current and "*K*" for capacity, the same as of old? Mr. Kennelly's argument that it were only courtesy that we adopt the letter "*I*," although almost every one on this side of the water as well as in England seems to have trouble with it, for the reason that foreign electricians submit to the introduction of unfamiliar letters on their own account, should not hold good in a case where actual danger of error seems apparent.
>
> It seems to us that no further or better argu-

ment is needed than here presented that the obnoxious "*I*" for current intensity should be banished from our thoughts. When the proof has passed through such careful hands as Mr. Pope's, been revised by two of the most punctilious scientists, the authors, Messrs. Steinmetz and Bedell, revised again by other members of the Institute, and finally passed to record in an erroneous shape in the *Transactions* of the Institute; when further, after error was suspected and the published article again submitted to the authors for information as to whether the error existed or not, and was again passed back with the endorsement O. K., notwithstanding that the error still remained,—we think that it is amply proved that confusion is likely to occur if any such notation is accepted.

Hous-Kennoolly says that "*I*" should be accepted for the sake of *courtesy ! ! !* And the *Electrical World*, of course, says "Amen." The latter journal, in its blind zeal to catch on, rushes into every open door that it comes across, hoping that if it misses 99 times it may strike it right the 100th time, and we hope it will, but the remaining chances are becoming few.

Courtesy if judiciously practised is a most commendable thing, but it may be carried too far, as the fly said to the spider.

We believe Hospitalier's notation is, in general, a good one, but we do not understand that he insists upon its standing just as it is in every detail. He has given this matter more thought, perhaps, than any one else in the world, and has offered his results tentatively to the public. We know, however, that he is willing to receive suggestions and criticisms, and if convinced that any changes would be for the better would be the first to accept them.

The ludicrous side of the whole thing is that Hous-Kennoolly thinks suggestions from certain quarters are laws, and the *Electrical World*, after having heard the Lulu bird sing "Thumbs up," turns thumbs up also."

* * *

History. It was just fourteen years ago last Christmas Eve that Mr. Edward M. Fox, a reporter on the New York *Herald*, went to Menlo Park to write up the first press exhibit of the successful result of Edison's work in perfecting the incandescent lamp.

The matter was kept secret up to that time through an arrangement between Mr. Fox, Mr. Charles Orr (the city editor) and Mr. Edison.

The *Herald* had a great scoop, and Mr. Orr and Mr. Fox were congratulating themselves over it when the paper went to press.

Suddenly Mr. T. B. Connery, the managing editor, appeared, with tears in his eyes, exclaiming:

"My ——, Orr, what did you mean by accepting this electric fake? What were you thinking of? The idea of lighting a room by electricity from suspended wires! It is ridiculous. How could you be so taken in? Was Fox drunk when he wrote this? What will Mr. Bennett say? What can the *Herald* say to square itself? We are all ruined!

Contrary to popular belief, this first *Herald* article was not paid for. It was printed as genuine news, which it was, and a very good story it made.

Subsequently, however, Mr. T. B. Connery, the doubting Thomas, was forced to resign under a cloud, charged with having accepted pay for giving an undue amount of space to Edison and the incandescent light. He is now doing literary drudgery in this city.

Mr. Fox subsequently went to England in the interest of the Sims-Edison torpedo project, and has lately returned to New York from Russia where he has been engaged in promoting the Harvey process of tempering steel.

Mr. Orr is now managing a successful newspaper syndicate in this city.

* * *

Early Multipolar Machines. Dr. Schuyler S. Wheeler, in his communication printed last week bearing upon the discussion of Mr. Dunn's Institute Paper, refers to what he terms an error of Tesla's in attributing to Mr. Edward Weston a great deal of important early work on multipolar machines, and says particularly of the windings referred to by Mr. Dunn: "I was surprised to hear them attributed to Weston, especially as I was not aware that he had ever done much in multipolar construction."

It is to be regretted that Dr. Wheeler did not make this statement at the discussion, and hence that Tesla was not called upon to make more clear the sources of his information in regard to Weston's work in this line.

The fact is that Mr. Tesla was right, and that Dr. Wheeler is evidently misinformed.

Weston began building multipolar machines for electroplating purposes as early as 1875. Before 1881 his company had sold over 2,000 of them, and also a few multipolar light machines.

Many of his patents, covering some of the very features referred to, were issued as early as 1877.

There should be a little further discussion of this subject, and we hope Mr. Tesla, or Mr. Weston himself, may be heard from in regard to it.

Under the Searchlight.

Views and Opinions on Timely Topics.

THERE was a well-defined rumor in the establishment of J. P. Morgan & Company on Saturday last that the Bate Refrigerator case was to be decided on Monday next adversely to the G. E. and Bell Telephone interests. This is probably correct.

Mr. Fish must have been misinformed; or was he talking through his $7\frac{1}{8}$ hat?

* * *

This Is One Question.

Our English contemporary, *Industries and Iron*, has this to say:

> A somewhat curious movement, of which we have by no means heard the last, is the "National School of Electricity." This concern is intended to cover America with teaching classes, claiming the support of Edison, Tesla and the most prominent scientific men in the United States. Its scope appears to be the foundation of local classes, with a curriculum similar to that of the City and Guilds of London Institute. The questions which have not yet been fully answered are, What instruction will students receive in return for their fees, and how far have the eminent men appearing on the "faculty" pledged themselves to work for and support the movement?

Another question is, How much longer will the reputable gentlemen whose names are now being used to further a fraudulent scheme consent to be *particeps criminis?* ELECTRICITY having pointed out the unenviable position in which these gentlemen have unwittingly allowed themselves to be placed, quite a number have taken steps to put a stop, so far as they are concerned, to this fraud. Strange to say, however, a few are still found who state over their own signatures that the use of their names *as used* is authorized by them and that they *are* members of the "honorary faculty." Does "honorary" mean "honorable," or does it mean $1,000 worth of stock?

* * *

We Never Touched 'Em.

(From the Western Electrician.)

The influence of ELECTRICITY on growing plants has been the subject of study and experiment at different times and by widely separated investigators.

* * *

Upholding "Electricity's" Course.

The Harness electropathic belt has occupied the attention of the English law courts recently, and the last action in which it or its vendors are the principal features, has, we suppose, been fought and lost. The crusade against electrical humbugs has been taken up by an esteemed American contemporary, which is engaged in an investigation of the "Electropoise," a cure-all which has attempted to obtain a place on the English market, but does not seem to have been acclimatized. If our contemporary achieves the success due to its bold endeavor to unmask an "electrical" appliance in which electricity plays no part, we can only wish it such success as has fallen to the lot of a London contemporary in its self-imposed and useful task.—*Industries and Iron.*

The First Gun.

Judge Seaman Releases the Sunbeam Lamp.

On Friday, at Chicago, Judge Seaman, in the United States Circuit Court, dissolved the injunction against the Sunbeam Incandescent Lamp Company.

Ex Solicitor-General Aldrich appeared for the Sunbeam Company.

ELECTRICITY extends the compliments of the season to the Sunbeam Company, and to the Messrs. Terry. May they live long and prosper.

New Mode of Mill-Lighting.

A new system of lighting has been introduced by Mr. Lester Betts, the manager of the Calcutta branch of the Oriental Telephone and Electrical Company, Limited, in the case of the Empress of India Cotton Mills, at Budge-Budge, which are entirely lighted from the outside, special zinc fittings with 50 C. P. lamps being fitted to each window. This system, which has proved a complete success, saves the extra premium for fire insurance.

Personal.

Mr. John B. Wallace, of the Wallace Electric Company, Chicago, was in New York last week.

Messrs. J. W. Godfrey, F. W. Harrington and J. B. Olsen, now with the New York India Rubber and Gutta Percha Insulating Company, are cosily settled in their new offices at 18 Cortlandt street.

Mr. George J. Jackson, of the Norwich Insulated Wire Company, who was confined to his home for several days, is again able to attend to business.

Popular Electrical Science.

VI.

Thermo-Electricity—Detecting a Difference of Temperature of One Five-thousandth of a Degree—The Bolometer and the Measurement of the Temperature of Star-light—One One-hundred-thousandth of a Degree of Temperature.

BY NELSON W. PERRY, E. M.

It was Seebeck who first noticed that when the junctions of two different metals were kept at different temperatures a current of electricity was generated, or more properly speaking, that an electromotive force or electrical pressure was generated, which would give rise to an electric current if the opportunity were afforded it by closing the circuit. Seebeck's original apparatus consisted of a bar of copper and one of bismuth, bent so that when the two were soldered together at their ends they formed a quadrilateral, in the center of which was suspended a sensitive compass needle. He found when one of these junctions was heated by a lamp that the needle within was deflected either to the right or to the left, which indicated that an electric current was passing around the circuit composed of the two bent bars of metal. He found also that if he cooled the opposite end the result was the same, and that by heating one end and cooling the other the effects were intensified. In this and other ways he found that the intensity of the current was proportional within somewhat wide limits to the *difference* of temperatures of the two junctions, and that this current continued unchanged so long as the differences of temperature were maintained.

Further investigation showed that *any* two metals whose junctions were unequally heated were capable of giving out like currents, but that they differed materially in their adaptability to this purpose. To electricity generated in this way Seebeck gave the name "thermo-electricity" to distinguish it from electricity generated in other ways. It is not to be supposed that thermo-electric currents differ in any way from other electrical currents, for they do not—the name merely indicates the method of generation.

In his original experiments, Seebeck found that when a junction of copper and bismuth was heated the current flowed *from* the bismuth *to* the copper. Bismuth is therefore said to be thermo-electrically positive to copper. Testing a large number of metals together, he arranged a table of metals in thermo-electrical order as follows:

—Antimony.
Arsenic.
Iron.
Zinc.
Silver.
Gold.
Tin.
Lead.
Copper.
Platinum.
Cobalt.
Nickel.
+Bismuth.

This arrangement is such that every metal in the list is thermo-electrically positive to that metal which precedes it, so that if any two of them be soldered together and one of the junctions be heated, an electric current will be generated that will flow *from* the one lowest on the list *to* the one highest on the list. Since every metal is thermo-electrically negative to that which immediately follows it, the further apart the two metals selected are on the list the better the thermo-electric effect of heating their junctions, and antimony and bismuth being at the two extremes, will form the most sensitive or efficient thermo-electric battery possible with the metals enumerated.

Since Seebeck's time, the list of substances from which thermo-electric currents can be generated has been very widely extended, until it includes almost all substances known to man that are capable of manifesting electrical qualities. In fact, the tissues of the human body, as well as those of the lower animals, manifest thermo-electric properties towards each other, and it is impossible for the slightest changes of temperature to take place without the production of thermo-electric currents. Just how far these currents play an important part in the animal economy, in sickness and in health, is not yet known, and probably never will be fully known, for we cannot imagine life under conditions wherein they will not be produced. When we understand that a muscle cannot move whether it be by volition or involuntarily; that the heart cannot beat, the lungs inhale or exhale air, one point of the body be even momentarily hotter or colder than another, without supplying the conditions for thermo-electric currents, we will understand that the very conditions of life are those which postulate thermo-electric currents. Nor are they absent in death, for the tissues still remain, and differences of temperature will always exist. Electricity is not, therefore, life, as some empiricists would have us believe, for if that which is present in life exists also in death it cannot surely be the essence of life.

But one of the chief points of interest to the physicist in the phenomenon of thermo electricity is that it affords us a means of direct conversion of heat energy into electrical energy. In the dynamo machine we have a direct conversion of mechanical into electrical energy, but through what a long cycle of changes do we get our mechanical energy from our fuel? We burn our coal, and by means of the chemical energy of combustion produce heat energy. Much of this is wasted up the chimney, but a small portion of it is taken up by the water of our boilers and takes the form of steam. This is carried to our engines after considerable losses from radiation, etc., and there with further losses, due to friction, leakage and condensation, is converted into mechanical energy. The losses due to these various steps are so great that the best we can do now with the largest triple expansion condensing engines is to obtain about 13 per cent. of the energy we started with in the coal in the form of mechanical energy. To convert this small remainder into electricity by means of the dynamo, which is the most efficient method we have at present, involves a further loss of from 5 to 10 per cent. under the most favorable conditions, and from 15 to 25 per cent under usual conditions, so that it is seldom that we get as much as 10 per cent. of the energy of our coal in the form of electricity. If on the other hand we could convert heat directly into electricity, most of these losses would be obviated at once, and where we now get but 10 lamps from a given quantity of coal, we might be able to get 50 or 75. This prize—the discovery of a means for the direct conversion of heat into electricity—has been too great to have escaped the notice of investigators, and the thermo-electric battery seemed to offer a solution of the problem, but it is found that the losses by this method are far greater even than those involved in the steam engine and its accessories. At least they have thus far proved so, but the hope has not been entirely abandoned that some combination of elements will yet be found by which electricity may be economically generated from heat by thermo-electric means.

When two metals are soldered together as described they form what is called a thermo-electric cell or couple. Any number of these cells may be connected up together in the form of a battery in the same way as galvanic batteries are connected up—in series to increase the voltage, or in multiple to increase the current strength. In thermo-electric batteries the cells are usually connected up in series and so arranged that the odd numbered junctions all face one way and the even numbered junctions face the other way, so that the proper ones may be simultaneously heated and cooled by applying hot and cold surfaces to the opposite ends of the pile. Fig. 1 represents a thermo-battery, or thermopile as it is usually called, consisting of alternate bars of bismuth and antimony. Now if the odd junctions, 1, 3, 5 and 7, be either heated or cooled to a greater degree than the even ones, 2, 4, 6, and the terminals of the two end bars be connected by a wire, a current of electricity will be caused to flow around the circuit and will give indication of its presence by the deviation of the needle of a galvanometer *G*, if the latter be placed in the circuit as shown. Fig. 2 is a much more compact form of thermopile, such as is usually employed in physical investigations. The current generated, even where the number of cells is very large, as in Fig. 2, is exceedingly small, but by means of a delicate galvanometer even infinitesimal currents can be detected, and we have thus a very sensitive electrical thermometer, for if one end of the thermopile be turned towards and the other away from a source of heat the alternate junctions will be heated unequally and a current will result. According to Melloni, so small a difference of temperature as $\frac{1}{5000}$ of a degree of temperature can thus be certainly detected. Few of us realize what this is, for the human system is scarcely conscious of changes of temperature of less than two or three degrees, and ordinary mercurial thermometers are only graduated to single degrees—oftener to two degrees. But when it is known that by means of such an instrument, which is shown ready for use in Fig. 3, the passing of a man on the other side of the street can be readily detected by the increase of temperature of that side of the pile, due to the heat radiations from his body, some conception can be formed of its delicacy. In this instrument, Fig. 3, *P* is the thermopile; *m* and *n* are two binding posts connected with the extreme elements of the pile and to which the wires *a* and *b* leading to the galvanometer are attached; *C* is simply a large conical tube intended to collect the heat radiations emanating from the heated body and to concentrate them upon one end of the thermopile. Thus it will be seen that this instrument which is of extreme delicacy is also extremely simple. It is also so reliable that it has been of the utmost service in physical investigations of various kinds. By means of this instrument we can readily prove that each of us as we walk around carries with him an enveloping cloud of influence extending in all directions into free space—in-

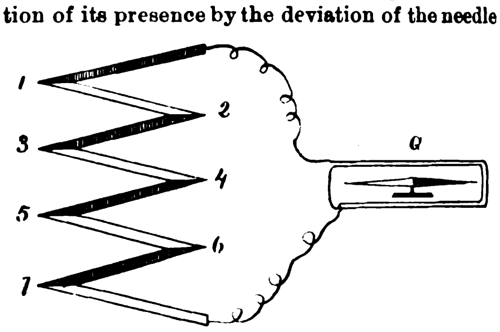

FIG. 1.

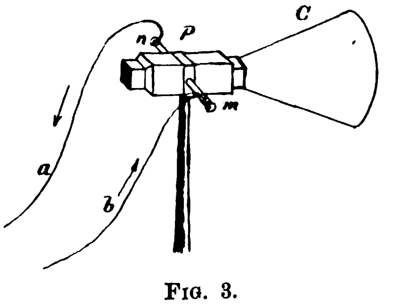

FIG. 3.

visible to the eye, it is true, but readily capable of measurement, as we have seen. Were this cloud or halo sufficiently tangible for our crude, unaided senses to disclose, we might see the haze or ghost of our friends long before we could penetrate its veil and see them in *propria persona*. How strange the sensation would be were we suddenly gifted with the power to discern these radiations, to watch the ceaseless throngs on a busy thoroughfare! We would see not the people themselves who formed the center of radiation, but rather would we see large spheres many feet in diameter dodging here and there, striking each other without collision—passing through each other without the disturbance of either—and then, if our sight were keen enough to penetrate these spheres, we could see that each was actuated by a sentient human being bent on business of his own which conflicted with that of his neighbor no more than did his surrounding sphere interfere with or distort the surrounding spheres of those with whom it came in contact. Verily, there is an unseen universe of which the layman has little knowledge, simply because there are no human senses by which it can be appreciated. Science, however, is coming to our aid and furnishing us ears to hear that which we cannot hear and eyes to see that which we cannot see.

It must not be surmised that these spheres are spheres of heat, as the term is popularly understood. Heat rays like light rays will pass through a lense of ice without melting it, and by this means may be concentrated to a focus so as to ignite combustible substances.

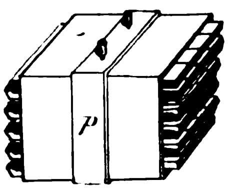

FIG 2.

All of the heat which the earth receives—the warmth of the sunshine—passes unmodified through over 92,000,000 miles of space supposed to be at a temperature of over 400° below zero, yet it produces no effects of sensible heat until it strikes our atmosphere. Heat, then, in the abstract is but a mode of motion of the all-pervading ether. It is but the ripples in this vast ocean which extend out into all space in ever-increasing concentric spheres from the central heated body, and differs only from light in the length or frequency of these waves. When these heat waves, as we shall call them now, strike a retarding medium such as ordinary matter they give up their energy to the molecules of the latter and we have the phenomena of sensible heat. All ethereal waves are thus capable of being retarded by common matter and their energy degraded into heat, and by the phenomena of heat only are we able to recognize many of these. For those waves of a higher frequency we have a special sense organ, viz., the eye, but even these when falling upon a black substance, or anything else that will not totally reflect them all, are also degraded into heat and become sensible as such also.

In a previous chapter I endeavored to explain by means of a water analogy the *rationale* of the phenomenon of electro-magnetic induction, whereby when these etheric waves were intercepted by a closed electrical conductor alternating currents were induced in that conductor corresponding in frequency with the oscillating electrical current which originally gave rise to the etheric waves. These etheric waves were of exactly the same kind as the heat and light waves which are now being discussed, except that as produced artificially they were much longer. I endeavored to point out that if by artificial means we could produce those waves with a frequency of about 500,000,000,000,000 per second, and none others, we would have light practically without heat, viz., that our sense organ for light would respond to all of the waves sent out instead of to but a very small proportion of them, as it is able to do to the heterogeneous waves sent out from an ordinary hot luminous body.

But if these longer waves will induce oscillating currents of electricity in conductors which intercept them, why will not the shorter heat waves and the still shorter light waves do the same thing? Simply for the same reason that the compass needle will not be deviated either to the east or to the west by ordinary alternating currents—because of its inertia. While electricity is not supposed to have either weight or inertia, when it is associated with matter it has something very like it, and electricity at rest in an ordinary conductor, when impelled by alternating impulses succeeding each other so rapidly as do those impressed upon it by heat and light waves, refuses to move in either direction as does the compass needle. But now supposing we construct a mechanism which will do for electricity what a check valve does for water, viz., permit its passage more readily in one direction than in the other, then if we impress upon our fluid rapidly alternating impulses, those in one direction will be partially annulled by the valve, while those in the opposite direction will all be taken up by the fluid and motion will result in that direction. A junction between two dissimilar metals seems to be some such contrivance as this, and therefore when the electricity in the two bars is hammered in opposite directions billions of times per second, motion is produced in the direction of least resistance. This hypothetical valve, however, must work with equal or nearly equal rapidity with the impulses to be effective, and the fact that we get but poor results, electrically speaking, from the thermo-electric cell indicates that the limit of speed of the valve is already exceeded by the frequency of the heat waves. With light waves, which are of greater frequency than those which we call heat waves, we would therefore expect no results, and we find none until they have been retarded to the frequency of heat waves.

A mechanism sensitive to light has, however, recently been described by H. Luggin in a German scientific periodical, consisting of two platinum plates—one coated with bromide of silver immersed in a solution of bromide of potassium, and the other a similarly coated plate exposed to the light, by which it is stated that a rise of potential of half a volt was obtained by exposure to diffused daylight.

But since all of the ethereal waves of which we are cognizant are exactly of the same kind and differ only in degree, and they all in swashing up against matter are capable of producing the same effect of heat, it is not entirely proper to distinguish one class of them as heat waves, another class as light waves and a third as actinic waves, etc., for there is no strict line of demarcation between them. A better appellation is the generic one of "radiant energy." We may then define radiant energy somewhat as follows: All transverse waves of the ether which radiate from a center in all directions are propagated into space with equal velocity, viz., about 186,000 miles per second. When these waves follow each other within a given range of frequency their sensible effects are chiefly heat. When they follow each other within another given range of greater frequency their sensible effects are chiefly optical, and when they follow each other with still greater frequency their distinguishing physical effects are chemical, but they all, of whatever frequency or other characteristic, may be degraded into sensible heat by being retarded or absorbed by material substances. Change of temperature therefore, becomes our best yardstick for measuring radiant energy of whatever kind, and to Prof. Langley is due an instrument by which radiant energy is thus measured. To this instrument has been given the name of "bolometer," and in it we have perhaps an instrument of the highest delicacy of any which human ability is competent to devise. If we are astounded at the delicacy of the thermopile by which a change of temperature of $\frac{1}{5000}$ of a degree can be detected, what will be our state of mind when we learn that $\frac{1}{100000}$ of a degree of temperature can be accurately measured? Yet that is exactly what the bolometer is capable of doing.

Like the other instruments of extreme precision already described, this one is extremely simple—ridiculously simple. Every one knows that a metal wire offers more resistance to the passage of an electric current when hot than when cold. Every one also knows that when light strikes a blackened surface none of it is reflected and that in consequence the surface becomes heated. This is also true of other forms of radiant energy, so that if we take a very fine wire and coat it with black pigment and concentrate the rays of radiant energy upon it, all of these rays will be absorbed and their energy degraded into heat, the wire will rise slightly in temperature and its electrical resistance be increased in proportion to this rise in temperature. It becomes necessary therefore only to compare the electrical resistances of the wire before and after it has absorbed the radiant energy under examination and the results sought for are obtained.

By this means the energy transmitted by rays of light from Mercury, Venus, Mars, Jupiter and Saturn have all been accurately measured and that of the light from Aldebaran and Polaris brought within our ken.

Effect of the Electric Arc on Carbon.

In the course of the series of experiments undertaken with the electric furnace during the past two years, M. Henri Moissan has had occasion to deal with the vaporization of carbon. After having detailed his investigations before the French Academy of Sciences, he concludes as follows: (1) that in vacuum, as in ordinary pressure, carbon passes from the solid to a gaseous state without assuming a liquid form, and from this point of view it may be compared to arsenic; and (2) when gaseous carbon reassumes a solid form it always furnishes graphite. M. Moissan estimates, however, that carbon can be brought to a liquid state, but this phenomenon would only be produced under the action of more or less strong pressures. In the case of high pressures, as his previous experiments established, the density of the carbon would increase and the diamond would be obtained. In fact, he has been able to prepare small diamonds. Both at the Cape and in Brazil diamonds are found which possess no trace of apparent crystallization, and which have rounded forms such as can be taken by a fluid maintained in the center of a "milky" mass. Carbon under pressure could then take up the liquid state and be solidified as water, either by presenting a confused mass of crystals or by taking a rounded and amorphous form.

Messrs. Crompton & Co., of London, England, have placed on the market an electric fire radiator, consisting of a wrought-iron basket filled with fireclay balls, which partly hide a colored incandescent lamp. The illusion afforded by this arrangement is that of a glowing coal fire in an open grate. The heat given out does not come, however, from the lamp or the fireclay, but from resistances concealed in the sides and back of the grate.

DIOPTRIC GLASS SHADES.[*]

BY A. P. TROTTER.

There are certain inventions, such as automatic tramcar starters, railway-carriage station indicators and telegraphs for transmitting writings and drawings, which seem bound to be invented and re-invented at regular intervals. The reason is that they are not particularly hard to invent, and each inventor, because he does not see them in common use, thinks that he is doing original work. The construction of reflecting or refracting appliances for the diffusion, and more particularly for the uniform distribution, of light is, I believe, another example of this class. These problems have been solved, and repeatedly solved, because up to the present there has been no real demand for them, because they are expensive luxuries, and because there is generally some unforeseen difficulty in the way.

The first attempt to distribute light uniformly is to be found in the patent of Smethurst & Paul, No. 2,654, 1802. They describe a reflector "that shall be so formed as to reflect those rays issuing from the flame of the lamp which without their interposition would fall in a direction in which they would be useless . . . in such a manner as to diffuse and distribute them over the whole surface or extent of space to be illumined, so that the whole of the light falling on every portion of such surface or extent of space, both from the direct rays of the lamp and after reflection from the reflector, may be as nearly equal and uniform as is practicable." This was a good beginning, but they merely attempted to superimpose a uniform distribution upon an area already unequally illuminated, and moreover, their reflector would not have fulfilled the problem, for they directed the rays at angles whose tangents are as 1, 2, 3, etc., instead of as $\sqrt{1}$, $\sqrt{2}$, $\sqrt{3}$, etc. I went into this question of reflectors in 1888, and wrote an article in *Industries*[†] on the subject. A reflector with an entirely wrong curve was patented a few years ago, but even this has not met with success.

The method of diffusing and distributing light by means of prismatic corrugations on clear glass has been attacked by several inventors. The last example, that of MM. Psaroudaki and Blondel, has been recently described in detail in the French electrical journals.[‡] Two years ago M. Fredureau described a somewhat similar invention before the Académie des Sciences,[‖] but it is not quite clear whether he aimed at distribution or at concentration only. The specimen of his globe which I have seen appears to be suitable for directing most of the light downwards in the neighborhood of the lamp. Some years ago, M. Weissenbruch proposed, and possibly made, some shades for the uniform distribution of light; but I have never seen any account of his invention. The shades of MM. Psaroudaki and Blondel are now being placed on the market by MM. Englefred et Cie., of Paris. Whatever work M. Blondel puts his hand to is sure to be well done, and I have no doubt from examination of the details of his system that the globes will do all that is claimed for them. My own work in this direction has been heard of now and then, but the reasons why the shades themselves are practically unknown and forgotten may be worth relating in connection with this recent invention which so closely resembles them. As no account whatever has been published of my dioptric shades, I venture to give their history as briefly as possible, for the purpose of comparing my experience with the prospects of this latest invention.

In 1879 I saw a short article, or letter, in some technical journal for which I have more than once searched, but which I have never seen again. The excess of light in the neighborhood of a lamp-post—an arc lamp I think—was pointed out, and some suggestion was made for distributing the illumination, probably by reflectors. Soon after this I sketched an arrangement of prisms, but did not spend much time upon the matter until 1880. I only hope that MM. Psaroudaki and Blondel used some such device as that which I employed for the laborious calculations. In Deschanel's Physics, a graphical construction is given for finding the path of a ray through a prism. It is easy to convert this diagram into an instrument, and such an instrument[*] was made for me by the Cambridge Scientific Instrument Company in 1880. The curved faces of my prisms were calculated approximately as polygons. One set of these, for a single pane of glass, ran into nearly 3,000 separately calculated angles. After visiting the Paris Electrical Exhibition in 1881, and finding nothing of the sort there, I applied for a patent, No. 3,515. In July, 1882, I went round to four large manufacturers of flint glass ware, but after examining my drawings, templates and plaster models, they all declared that it would be impossible to mould such things. One of them, on being asked the value of the refractive index of his flint glass (an absurd question to put to a glass maker), replied, "Value? why it has not got one!" But in August, 1882, Messrs. Greener & Co., of Sunderland, undertook to try the job, and the patent being too far gone to be proceeded with, was again applied for in January, 1883, No. 233. At about the same time the French, Belgian, Austrian, American and German patents were applied for. The German office objected that the idea was very old, and referred me to descriptions of lighthouse lanterns. The others[†] were granted, and were handed over to an agent, who, if I remember right, allowed them all to lapse without doing anything with them. The first lantern was tried at the Millwall works of Messrs. Latimer Clark, Muirhead & Co. No photometric measurements were made, but it was evident that a certain distance from the lamp there was more light with the lantern than without it, but the weight of the glass was terrible. The manufacture was soon afterwards taken up by Messrs. Moore & Sons, of South Shields, who executed the difficult task of cutting the iron mould to the templates with great accuracy. The scientific part of the invention was described in a "selected Paper" of the Institution of Civil Engineers, Vol. LXXVIII, p. 346. An excellent abstract of this, in French, with illustrations, appeared in *La Lumière Electrique*, Vol. XIV, p. 98, October 18, 1884. No account has ever been published in an English journal; the details are of purely optical interest.

Seeing that I had in view two definite problems, namely (1), the diffusion of light without the loss caused by ground glass or opal shades, and (2) the distribution of light as uniformly as possible over a definite area, and that I set about it by simple geometrical optics, it is not surprising that the French inventors, attacking the same problems by the same means, should have arrived at results which are in many details identical with mine. I studied the question of diffusion (totally different from distribution) because it seemed likely in 1881 that glow lamps when improved would be so bright as to be unbearable to the eye unless shaded. As a matter of fact, lamps were run then a good deal brighter than was the fashion in 1893. My diffusion shades were cylindrical with a hemispherical bottom. Flutings were formed by mouldings, both on the outside and on the inside. To enable the moulds to strip, the outer flutings ran round in rings and the inner ones ran up and down. The French shades are globular, each half being exactly like the bottom of my shade.

A circular fluting is not the best form, and the French inventors seem to be of the same opinion, as is shown in the accompanying illustrations.

My shades multiply the source of light into about 300 little images, each well formed and distinct, and, of course, $\frac{1}{300}$th of the power of the original. They were used to light the subway from the South Kensington Station to the Health Exhibition in 1884. I only know of three in actual use to-day; these are on the staircase of the *Standard* office, and I look affectionately at them when I go down Shoe Lane. I know a man who found them useful for mixing paint in. I have none in my own house; I am difficult to please in the matter of fittings. Mr. Moore asked me in 1885 whether my invention could not be adapted to gas burners. I unhesitatingly said "No! because a gas flame is so widely different from a mathematical focus, and all my calculations would be thrown away." He soon afterwards applied the patterns used on his imitation cut glass jelly dishes to gas shades, and I am glad to see them in use in hundreds of thousands. I hope he has recouped himself for the large cost of my moulds, to which he would not allow me to contribute, since it was not his custom.

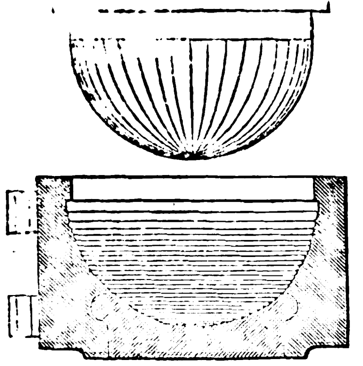

FIG. 1.—MOULD FOR MAKING FRENCH SHADE.

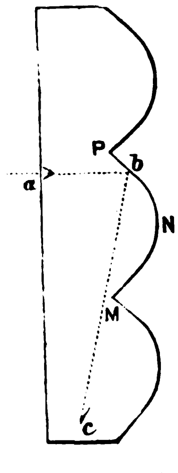

FIG. 2.—(From *L'Industrie Electrique*).

The French invention is, as might be expected, more tasteful, and, indeed, I tried to introduce the same form in 1887, but was advised by the largest dealers in electrical supplies, who had handled my shades in small quantities, that a globular shade would not "take," and they did not care to give an order to help to start it. I went as far as making templates and plaster models, but under the circumstances Mr. Moore did not care about touching it. I think it would have been a useful and far less ugly shade than my first. Mr. Stepney Rawson estimated the absorption of light to be about 3½ per cent.; this is impossible, but neither he nor I could account for so small a loss. I believe it to be about 8 or 9 per cent. when quite clean. But here comes one of the great difficulties. Such shades are very liable to catch the dirt. Mere wiping is of no use, they must be washed and scrubbed. This has been simply fatal to the more important class of shades, to which I must now pass.

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[*] From "The Electrical Review" (London).

[†] "Industries," Vol. V, p. 532.

[‡] "L'Eclairage Electrique," No. 7, October 27, 1894, p. 368; "L'Industrie Electrique," No. 67, October 10, p. 438; "L'Etincelle Electrique," No. 1, p. 1, November 3, 1894.

[‖] "Comptes Rendus," Vol. CXV, p. 1,064, December 12, 1892

[*] "Engineering," Vol. XLVII, p. 559, May 17, 1889.

[†] American, No. 330,356, 1885; French, No. 153,303, 1883; Belgian, No. 60,328, 1883; Austrian, No. 7,228, 1884.

The methods adopted by the French inventors for the uniform distribution of light are a good deal more complicated than those which I employed. They make use of internal reflection to a considerable extent, and the profile of some of their prisms is very intricate. This must entail very expensive moulds (one of mine cost £40, if I remember right), great care in annealing, lest the sharp angles become rounded or the whole shade warped, and the difficulty of cleaning seems to be very serious. The general outline of the French shade has an immense advantage over mine from an æsthetic point of view. Theirs is a beautiful sparkling globe and mine was a particularly ugly lantern.

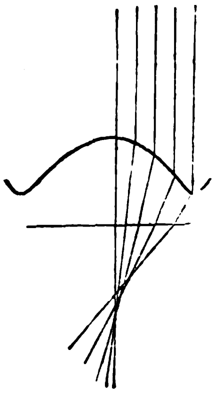

FIG. 3.—(From *Proc. Inst. C. E.*)

I was so careful of the theoretical design that I never gave the beauty of the shape a single thought. My lantern was designed on the assumption that no useful light is emitted upwards from an arc. The horizontal ray strikes the glass at 45°, and becomes refracted in the thickness of the glass through 17°, and is therefore well on its way downward before it reaches the prisms. The special shape of the French globe does not take advantage of this angle of incidence. Considerable quantities of my glass for lanterns were sold in 1884 and 1885, but I do not know of the existence of a single lantern now. I have not even got a sample pane. One company who took the largest quantity, from motives of economy or æsthetics, upset all my mathematics by using only eight panes instead of ten in each lantern, thus making the sides much steeper. I was always too disgusted to calculate what really happened under these conditions, but I was not surprised when their orders stopped. One of the large galleries of the Health Exhibition was entirely lighted with my lanterns, and the jury, after carefully examining the uniformity of the illumination, awarded me a silver medal. After ten years' internal reflection and experience with photometry, I am inclined to think that the distribution of illumination in this particular case would have been just as good without my patent glass, and I cannot make up my mind what to do with the medal.

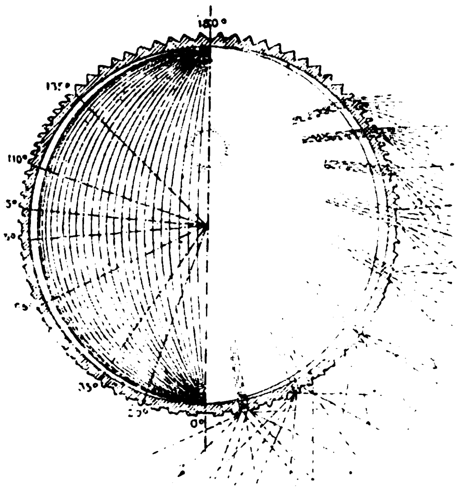

FIG. 4.—(From *L'Industrie Electrique.*)

For widely-spaced lamps on fairly high pillars, it is certainly possible by means of either of these inventions to distribute the light fairly uniformly over a definite area. But the real question is: Does anybody really want this? I once thought that it was of manifest importance, but to-day I am convinced that for ordinary street lighting a distribution such as that which is to be found in most of the streets in St. Pancras is quite uniform enough for all practical purposes. True, the parts midway between the lamps are dimly lighted, but if the superfluous light were taken away from the brilliant parts, and were spread over the dark parts, I believe the general effect would not be so useful as at present. This was the object of my invention; and, if I understand the matter rightly, this is what MM. Psaroudaki and Blondel are attempting to do, and no doubt succeed in doing. But the superfluous light is shed over a very small area, and the dimly-lighted space is large, and the superfluous light would go a very little way towards illuminating it well and is more useful where it is. I have only come to this conclusion by careful observation and actual measurements of street illumination during the last two or three years.

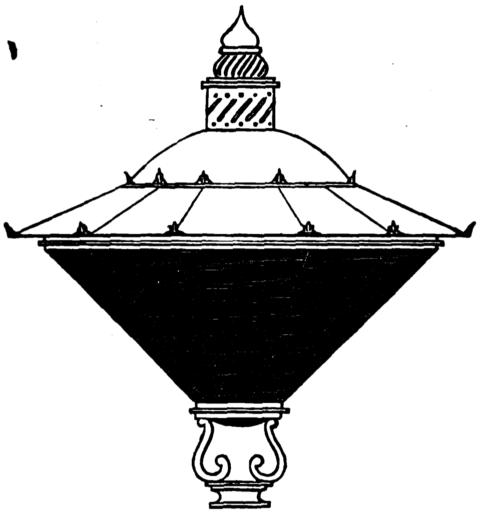

FIG. 5.—(From *Proc. Inst. C. E.*)

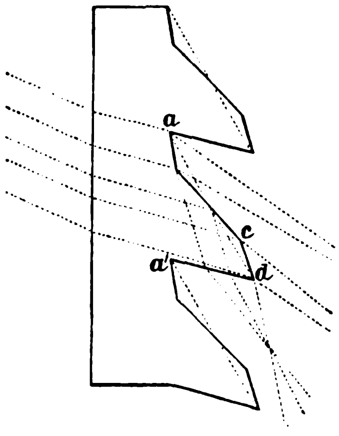

FIG. 6.—PROFILES OF PRISMS. (From *L'Industrie Electrique.*)

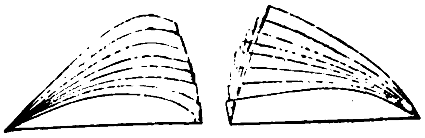

FIG. 7.—PROFILES OF DISTRIBUTING PRISMS. (From *Proc. Inst. C. E.*)

A smaller distributing shade moulded in one piece was tried in "the Wimbledon experiment" of 1884. The photometric tests, according to Mr. Preece's report*, were very satisfactory, but the general effect to the eye, which is, after all, the main test, was no better than that of a well-designed reflector, costing 1s. to 1s. 6d. By the by, I designed that reflector.

As an improvement on existing arrangements of lighting, I do not think that these inventions will, by their distribution of the illumination, outweigh the expense of the glass, the cost of special frames or lanterns, and above all the difficulty of cleaning; but it remains to be seen whether by the use of this system three lamps may be made to do the work of four. That is a much more important matter. I used to claim that this could be done and no one ever took the trouble to refute me. I am inclined to doubt the practical value of the German inventions recently described by Mr. Rankin Kennedy in these columns. Their aim is the same so far as distribution is concerned, but they do not combine diffusion with it, as in the present invention and in my own attempt. The practical difficulties seem to be far greater.

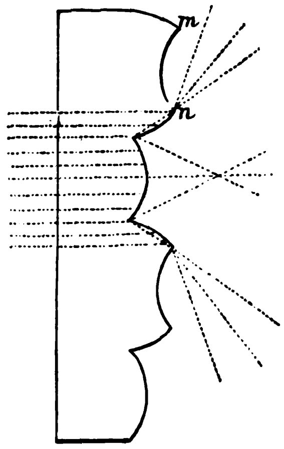

FIG. 8.—PROFILES OF PRISMS. (From *L'Industrie Electrique.*)

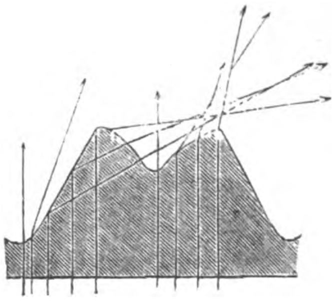

FIG. 9.—PROFILE OF DIFFUSING PRISM. (From *Proc. Inst. C. E.*)

Only a year or so ago I made a final attempt to apply this dioptric system in its most simple form to sheet glass for glazing alternate current arc lamps, with the object, not of attempting uniform distribution, but of deflecting the light, which is wasted upwards, towards the outer parts of the neighborhood of the lamp. I intended to use convex and concave curves alternately, leaving no sharp edges or deep grooves, which are so difficult to clean, to make all necessary sacrifice to mathematical ideals in order that the ordinary steep inclination of the panes might be retained, and if possible to arrange that the glass could be rolled in large sheets and cut up in the ordinary way. I made a proposal of this kind to an electrical manufacturing company, but was courteously informed in suitable language that they understood their business much better than I did—and, of course, they were right.

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* "The Electrical Review" (London), Vol. XVI. p. 397, May 2, 1885.

So far from wishing in any way to diminish the credit due to MM. Psaroudaki and Blondel, I only hope that any hints taken from my experience of this rather fascinating problem may be of use to them. I look forward to, and anxiously await, the success of their invention, for when it comes—and I will do all in my power to hasten it—I shall have the satisfaction of feeling that I was twelve years before my time.

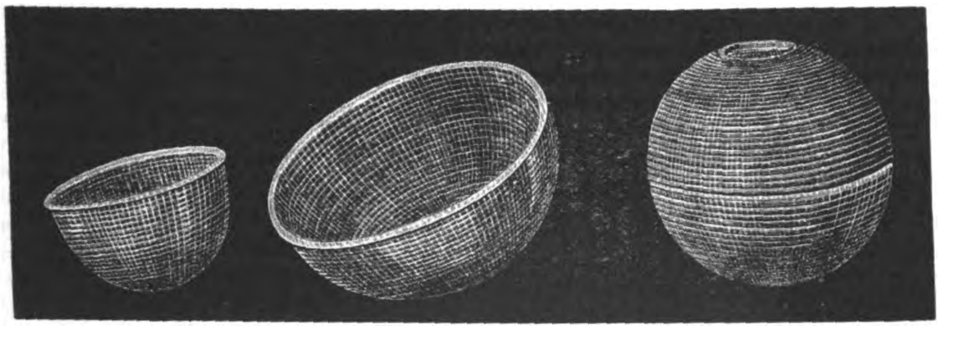

Fig. 10.—Holophane Globes.

NEW SOURCES OF ELECTRIC POWER.*

ELECTRIC ENERGY DIRECT FROM THE COAL FIELDS.

In a recent article in the *Times* it was stated that, if the history of the present century could be represented by the use of one word, that word would be steam.

Probably the word invention would more adequately represent the source of the great changes in the social and industrial life of this last century; nevertheless, the word steam brings to mind at once the colossal effects that this power-generating agent has produced, crushing out of existence nearly all the other agencies that man relied upon to assist him in his work, and providing in its *ensemble* of application an equivalent power for work that could not be equaled by millions of able-bodied men.

More than ever, in this era of industrial struggles, cheapness of power is likely to be the principal and all important factor of value in fixing upon suitable sites for the establishment of new industries.

For the production of power for industrial purposes one of three natural agencies is usually employed: e. g., the fall of water; the influence of wind currents; and the development of work by the production of heat by the combustion of coal or other forms of available fuel.

In England, the secret of our industrial greatness, and, in a measure, the cause of our commercial supremacy, may be revealed in our unrivaled facilities for the production of power by the third agency, or heat-power.

Our splendid fuel resources permitted our ancestors to obtain full justice for the fruit of the inventive genius of Watt, Trevithick, Stephenson, Crompton, Kay, Arkwright and others, enabling our manufacturers to flood the world's markets with the marvelous products of our looms and of our forges through an era of unexampled prosperity that extended over a quarter of a century.

In this golden period of prosperity our people accumulated enormous wealth, a great part of which is invested in foreign bonds and railway developments. The extent of this wealth will be realized when it is known that in our country income tax is paid on £764,000,000 of foreign Government stocks.

This enormous wealth-potential could not have been accumulated had we not had the mineral treasures in our coal-fields; and every discovery, invention, or scientific application that will assist in increasing the value of these mineral treasures becomes at once of national importance.

A discovery in applied science that deserves to rank with the invention of Watt for the utilization of steam-power purposes was the invention by the illustrious Michael Faraday of the dynamo electric-generator.

The value of this invention of 1826 was increased beyond all calculation by the accidental discovery, in 1873, of its reversibility.

It appears that the Gramme Electric Company were exhibiting two dynamo electric-generators at the Vienna Exhibition for lighting purposes.

One of these machines was in motion, the other idle; a workman, seeing some electric cables trailing on the ground, thinking they belonged to the second machine, connected the cables to the terminals of this second and inactive machine. To his surprise, the armature of this machine *commenced to revolve*, proving the reversibility of the dynamo electric machines.

This discovery will have an effect on civilization that cannot be weighed or foreshadowed. Great as have been the influences of the use of steam power on modern life and civilization, compared with the possibilities of electric energy as *the* method of applying and transmitting power, the influences of steam will become almost trivial.

When it is understood that power can be generated in one locality, and that this power can be transmitted by suitable conductors to distances of over 100 miles, and delivered with at least 75 per cent. of the original power, the possibilities of application of this new agency for transmitting energy may be realized.

This fact of modern applied science, proved as it was to the hilt by the famous Lauffen-Frankfort experiments of electrical transmission over 112 miles, has permitted waterfall sources of power to be utilized; and in no country more than Switzerland, where the influence of the magic energy has been most beneficial, and languishing industries in this Alpine region have not only been stimulated, but the interesting and romantic Swiss race has taken time by the forelock in applying to the full the bounty that nature and science have enriched them with, and many a new lucrative industry has been created, and is flourishing, that would never have existed but for this wonderful electric energy.

The power-producing potential of the mighty Niagara is also being tapped; a large conduit has been constructed near the falls, through which enormous volumes of water swiftly flow, and drive immense power producing turbines having a total power-output of 100,000 horse power.

The enormous power that can be drawn upon for transmission purposes from the Niagara Falls will be understood when it is known that the weight of water that passes over these falls is equivalent to the production of 7,000,000 horse power per hour; so that by electrical transmission a great part of this power required for the industries of North America could be supplied from the falls.

One of the most interesting examples of electric transmission of power is that of Tivoli, near Rome; here the antique and modern engineer join hands.

The water delivered from the old Roman aqueducts at Tivoli drives very powerful turbines and an electric generating plant, and the energy generated is transmitted by four copper cables to the City of Rome, some nineteen miles away, where it is distributed for lighting and power purposes—the water brought by those triumphs of Roman engineering thus serving as a means of lighting the superb monuments of the genius of the old Roman artist-architects.

On the Transvaal, South Africa, electric-power distribution projects are either in hand or under consideration for driving gold mining machinery with the power of waterfalls, miles away from the modern El Dorado, on the Banket gold-mining fields of the Randt.

Projects are being developed for utilizing the waterfalls of Finland for supplying electric power and light energy for the Russian capital.

Almost everywhere natural sources of power are being drawn upon, and already new industrial concerns are being established to take up the power from the Niagara turbines. It is intended in the near future to transmit the bulk of the power to the centers of industry in the Northern States of America.

When the natural forces of gravity are being drawn upon by our industrial rivals, the pertinent question for us is, Do we in England utilize our own natural resources in a manner such as to command the satisfaction of the progressive engineer? And again, Do we utilize to the full the advantages that electrical phenomena have revealed to us? To both these questions only one answer can truly be given, and that answer is a negative one.

With the exception of the splendid improvement introduced by the illustrious American, George Corliss, there cannot be said to have been any great revolution in the methods of converting heat into work through the medium of steam; but a brilliant innovation has been brought into the commercial field by the German practical scientist's (the late Dr. Otto) invention, by which, and without the intervention of steam, but by the direct combustion of fuel in the engine cylinder itself, heat is directly converted into work. This invention for small powers has had a wide application in recent years; nevertheless, in all our great industrial occupations the practical power-agency employed is still the steam-engine, and the coal has to be brought to our mills and works from coalpits miles away, by the agencies of cart and railway wagon; and the blackened and dirty, not to say filthy, condition of the buildings and streets of our towns, and the insult to nature by the pollution of our rivers and of the atmosphere with dirty and wasteful industrial effluents, might well increase and bring in the hatred of the lover of art and nature, such as is John Ruskin, against the development of the application of practical science for the convenience and well-being of civilized humanity.

Our cities are almost unfit to reside in, and the natural life of the Zulu, or the simple life of the Italian peasant, is much to be preferred to that of the English workman, with his daily grinding labor amidst the dirty surroundings of our smoke-begrimed industrial centers.

If wealth requires that the beauties of nature should be sullied by the production of effluents that offend all natural laws, better by far that we should have poverty, but with the great wealth of natural purity.

Fortunately, the discovery of the reversibility of the electric-generating machine, and the possibility of electric transmission of power under very high pressures, has enabled such a complete transformation to be effected in engineering procedure as to deserve the encomiums of Ruskin himself.

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* B. H. Thwaite, C. E., in "The Nineteenth Century."

With the modern and more scientific method of converting heat into work there is no necessity for the smoky factory chimney, which is a necessary evil of a steam-power station.

By the adoption of the new procedure with the electric agent the noise, dirt, and danger inseparable from our present steam-raising and power plants would disappear, and the present methods of power production would only be remembered as sources of worry and expense to the already harassed manufacturer.

Our large cities of Liverpool, Manchester and Glasgow obtain their water for domestic and industrial purposes from inland lakes miles away.

We have, therefore, splendid municipal criterions for the project of distributing electric energy from the coal-fields, a system that would sweep away at once all the disgrace that attaches to the existing methods of steam-power production, and which would be a benefit that would be truly national, covering, as it would do, both the manufacturer and the private citizen.

Briefly described, the project is to supply electric power generated in central stations built in the centers of our coal fields to our great industrial centers, and to the metropolis itself.

The power station for serving the metropolis would be erected on the Derbyshire coal field; an auxiliary station to serve the Midland Counties would be erected in the Staffordshire coal field.

The electrical trunk-lines would serve the larger towns en route, including Derby, Nottingham, Birmingham, Leicester, Northampton and Bedford. Distributing, transforming and storage stations could be erected near the metropolis.

The different metropolitan and suburban electric light stations could be supplied with energy for general distribution. Electric railways and other power stations could also be supplied.

Larger power consumers could be supplied with power direct.

Each vestry not already supplied with an electric generating plant could be invited to put down a distributing system and a receiving station.

The electric energy could be sold to the different distributing companies at such a price as to enable the power to be supplied to the light and power consumer at an economic and attractive figure, or at a little over one penny per kilowatt hour.

The industrial centers of Lancashire, Yorkshire and Cheshire would be supplied with electric energy generated in two coal field stations, respectively near Wigan and Barnsley.

The cost of power to the small factory owner need not exceed £5 per 3,000 working hours of one actual horse power of energy. In the metropolis, this energy by the present system will cost between £9 and £12.

This electrical power agency permits the starting or stopping of the plant by the mere turning of a switch or the pressure of a button.

Whilst the power plant is not actually doing work there is neither serious loss nor anxiety involved. The power user is not troubled with boiler insurance or the smoke-nuisance inspector; he may simply hire the electric motors, and when he decides to remove his manufacturing appliances, he has merely to return the hired motors, whereas a steam power plant with its chimney cannot, except with a great sacrifice, be removed.

If the system is carried out entirely, each machine can be driven independently by its own motor; consequently, the expensive items of belting, shafting and pulleys are almost entirely reduced.

Instead of having to run a 100 horse power engine to develop 20 horse power, which is with steam power an hourly possibility, with electric driving only the power required is produced, and the factory owner, or the power user, only pays for the actual power he absorbs in his work.

The centralization of the plant in the coal fields permits the recovery of all the valuable chemical constituents from the coal, which are not recoverable by the small steam power systems in use. One of these constituents, sulphate of ammonia, is of proved value as a manurial agent, and if this value were recovered from the coal raised from English pits there would be no necessity to ransack the fields of Chili and Peru for nitrates.

The centralization of power production would permit such an application of automatic or labor saving machinery as to make the plant independent of the effects following the differences that occur between capital and labor.

The method of transforming the fuel into power could be effected in such a perfect manner as to convert, as far as practicable, all the available heat into work, and produce such an efficiency as will be understood by the ratio of 0·75 lb. of combustible to one actual or available horse power of energy for the period of one hour.

The average consumption by existing steam plants cannot be taken as less than 5 lbs. of fuel for the same actual power during the same time.

In the transmission of this electric energy to the Midlands and the metropolis there will be a loss of, say 33 per cent.; so that the 0.75 lb. will be increased to 1 lb. of combustible per actual horse power per hour.

Compared with the transmission of the coal by cart and rail to satisfy the same power requirements in the metropolis, it will be realized that the equivalent of one ton of transmitted electrical power delivered in London is equal to three tons of rail-transmitted steam coal power; so that the relative cost of the two powers is, by the weight test, clearly in favor of the electrical power.

Further comparing in other respects the two systems of power transmission—the railway and the electric cable one—the permanent way of railways requires constant renewal, whereas the electric copper cable will be as good in twenty five years as when first established. The recent variation in the value of copper, of which the cables would be formed, has not been very serious and there is every reason to believe that the value of copper will be an ascending one.

As an investment, copper laid down as cables for transmitting energy power from the coal fields is as safe as if the copper were in the Bank of England.

Therefore the cost of laying down the cables, *per se*, should be covered by the issue of separate debenture shares at a little above the average bank rate of interest.

In the transmission of coal by rail the same coal wagons have to return the entire distance empty, because coal wagons are not suitable for any other kind of goods traffic.

The wear and tear of coal carrying railway stock is very great, and with the comparatively low rates charged for this traffic, considering its wear on the permanent way, it is questionable whether it is a desirable traffic for railway companies to have.

By the time the steam coal, costing, say, 4s. 6d. at the pit mouth, reaches the London terminus its cost has been increased to from 10s. to 11s.; the merchant's profits, coupled to the carting charges, brings the cost to 13s. at the factory or other consumer's stores.

Analysis shows that most coals contain from 5 to 10 per cent. of incombustible residuum, known as ash and clinker; it follows, therefore, that for every 1,000,000 tons of coal brought to London, from 50,000 to 100,000 tons of incombustible matter is carried.

This waste of carrying power, as well as the waste of coal in transit, will by electric transmission be entirely avoided.

The cost of the electric transmission cable and wayleaves, divided, as it would be, with the Midland consumers, would not fall heavily in the metropolitan area.

The trunk cables would be either suspended from poles *à la* telegraph, or be placed in underground trenches or conduits; there would be little, if any, greater difficulty in fixing up the power lines than with the telegraph or telephone ones.

For the transmission of 10,000 horse power three bare conductors for positive and three for negative currents would be used, equipped with oil insulators.

Lightning arresters would be arranged where the cables are overhead.

The pressure of the current (30,000 volts) would be transformed down to 2,000 volts at the Midland and metropolitan receiving stations, for the convenience of the local metropolitan companies, who can transform the pressure at their own stations down to their normal working and distributing one.

The distribution of the electric energy to the various Greater London electric supply companies, at a price of 2¼d. per kilowatt or electrical horse power, would permit them to sell the current to their consumers for 3d. to 4d. per kilowatt, instead of 7d. to 8d. charged by the metropolitan company for this equivalent of energy.

It would be impossible in the limits of this article to define with any degree of completeness all the benefits that would follow the application of that transcendent gift to man involved in the possibility of the long distance electric transmission of energy that recent science and discovery have unearthed from nature's secret stores.

The developments that have followed the invention of that imperfect instrument for converting heat into work by the agency of steam—the steam engine—have been of untold advantage to the human race, but the application of modern practical thermo-dynamics and electro-technics is destined to produce a still greater change and amelioration in the conditions of commercial, industrial and home life.

Electrical energy is almost daily being applied to new directions, and with almost marvelous results; so that, besides providing the *primum mobile* to our industrial ateliers, and providing a hygienically perfect illuminant, it gives the manufacturer the power of welding and annealing bars without a forge furnace, and enables him to melt both steel, iron, copper and brass rapidly and conveniently.

He can produce aluminium, chlorine, caustic soda; effect bleaching and tanning by electrolysis; and by the phenomenon of varying electrical resistance of different conductors he can effect cooking, evaporating and heating operations.

To the florist it offers a means of accelerating floral growth.

The energy can be utilized for ventilation, for actuating knife-cleaning, sewing and laundry machinery.

The electric energy generated in the coal field stations and transmitted to the industrial centers of England and to the metropolis, would enable the magic influence to be distributed to consumers at a price within the reach of rich and poor alike—a benefit for all and everyone.

TUNNELING UNDER LONDON.

The Waterloo and City Electric Railway.

(From our London Correspondent.)

London up to the present can only boast of the possession of one electric railway, that is the City and South London Underground. This line, which has now been running about four years, has experienced great difficulties in earning revenues sufficient to allow the payment of any dividend to speak of upon the ordinary capital. The last few dividends declared have been only ⅝ or ¾ per cent. The small area of the line has handicapped it most severely. An extension has been upon the rolls for some time, and in all likelihood active construction will be shortly commenced. As an electrical engineering enterprise the existing line is an undoubted success, the working expenses per train mile being exceedingly low. The freedom of the line from breakdowns and accidents, also constant and regular service of trains (every three minutes), are additional features of its success.

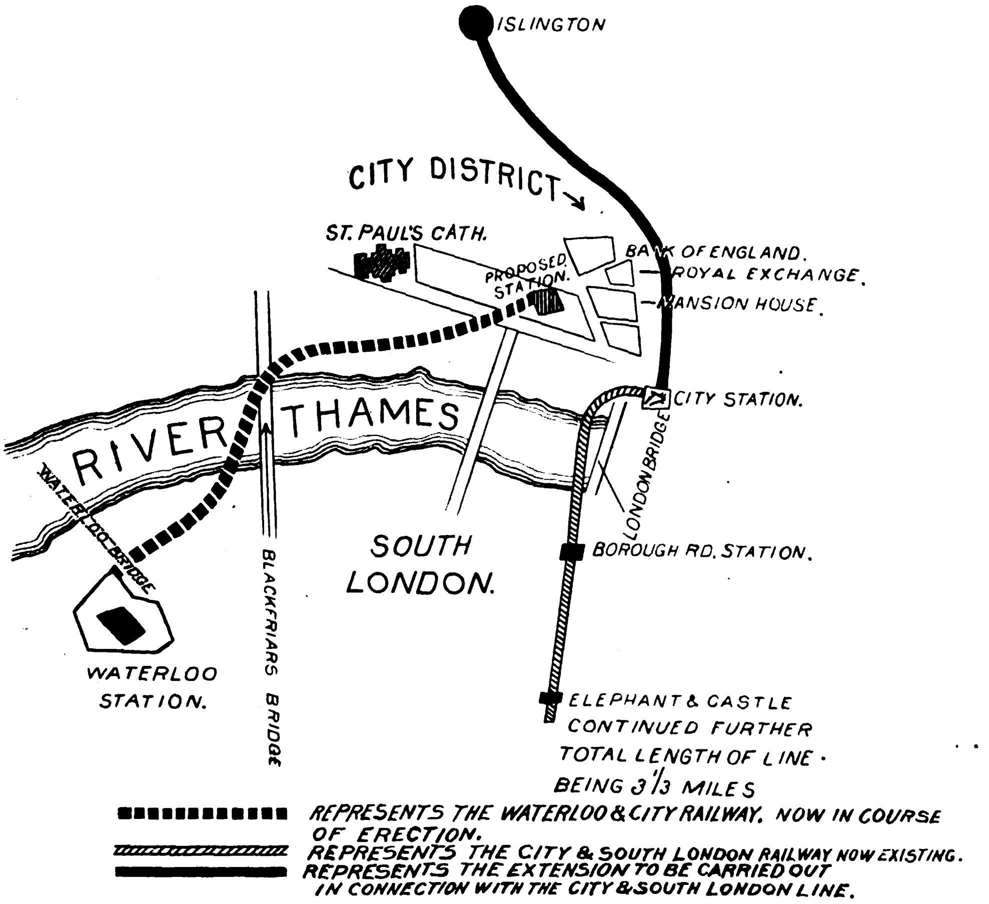

Fig. 1.

Financially, however, the promoters' expectations have not yet been realized, and it certainly seems that the only hope of it ever earning larger returns lies in the proposed extension to Islington. This extension would necessitate the running of the railway through some of the most thickly populated districts on the city borders where at present there is no very easy means of access to the City and Southern districts.

The fact, however, that the first scheme carried out in London has not been a fiscal success has not deterred other electrical engineering and railway men from undertaking the erection of a second line to be worked on the same system. It will run from Waterloo, taking its course under the river Thames, and thence to the Mansion House, the civic residence of the Lord Mayor.

Figure 1 shows roughly the direction of present line, the proposed extension; also the line just commenced.

The route this Waterloo-City line is to take is through the very heart of London City, so an overhead line would have been out of the question. It was, therefore, necessary that it should be taken underground, and as there already are in this part the Metropolitan underground steam railway, and the low level sewer, the tunnels have to be bored below both of these at a good depth. This is in one way an advantage, for below a certain depth nothing has to be paid for land rights. Fig. 2 shows the relative depths of the two railways and the sewer.

A few months ago operations connected with this new railway were commenced from the middle of the river. All the boring is done by means of electrical machinery; the shafts and tunnels where work is progressing are all electrically lighted, and a small electric locomotive carts away the soil to barges when it has been loosened.

The railway commences at Waterloo at a level of 36 feet below the South Western Railway, and then descends towards the river at a gradient of 1 in 60. Passing under the river the line is level for about 300 yards, and it then rises at 1 in 88 towards the city and terminates opposite the Mansion House. The tops of the two tunnels will be at a depth of about 24 feet below the bed of the Thames. The rail will be 62 feet below Trinity high-water mark. After passing below the river the next important crossing is the Victoria Embankment, where the rail level will be some 78 feet below the surface of the footway. The line goes below the District Railway a few yards further on. From the indication of the gradients it will be seen that the railway rises and falls somewhat after the manner of a switchback.

Direct transit without stoppages will be effected in about four minutes at an average speed of 22 miles an hour. The departure platform of the electric railway being only 36 feet from the surface the use of hydraulic lifts will be unnecessary, but they will be employed at the Mansion House terminus, where the rails will be about 66 feet below the level of the thoroughfare. The total length of the railway will be a little over 1½ miles. The traffic will be conducted by an up and a down line, each occupying a separate tunnel of cast iron running parallel to one another at a distance of about 4 feet. Where the railway is straight, or on a flat curve, the internal diameter of the tunnels will be 12 feet, but where the curves are sharp the tunnels will be enlarged in diameter to 12 feet 9 inches so as to prevent the possibility of the long bogie carriages which are to be used fouling the sides. Beyond the fact that electricity is to be the motive power the details are not yet settled, but the opening of the railway may be looked for about two years hence.

The station in the city will be entirely underground and passengers will be brought to the surface in capacious hydraulic lifts. The station tunnels, like the railway, will be of cast iron, built on Greathead's principle but of larger dimensions, namely, 23 feet internal diameter. Mr. Dalrymple Hay is engineer on the works.

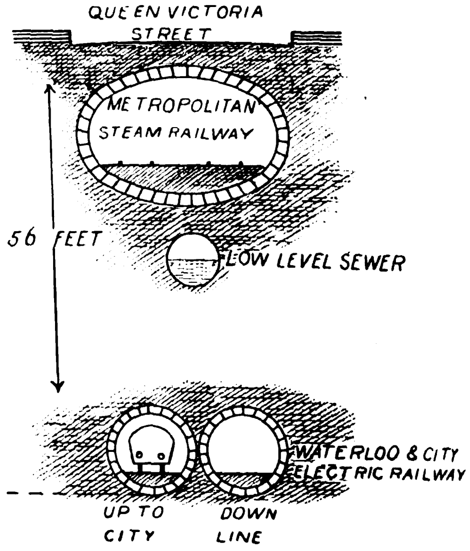

Fig. 2.

From near Hatfield street, towards the city, both tunnels will be in the London clay, which is a material specially favorable for tunneling operations, but from Hatfield street towards Waterloo as the line rises in that direction it encounters ballast. Here water will be met with in large volumes, so it will be necessary to construct this portion of the railway under compressed air as was done on the City and South London line by Mr. Greathead. Messrs. Galbraith & Greathead are the engineers, and the contractors are Messrs. John Mowlem & Co.

The shares in this Waterloo and City Railway Company are already being sold at a premium, although it is not likely that dividends will be earned for some years.

Mr. Dunn's Paper in Pamphlet Form.

The high educational value of Mr. Dunn's Paper on "Direct Current Motor and Dynamo Design," published in Electricity, and the general demand for it in convenient form for preservation and reference, has induced the publishers to announce that it will be issued in pamphlet form. Those desiring copies may procure them by addressing the undersigned. Price 10 cents per copy, postage paid.

Electricity Newspaper Company,
6 Park Place, New York.

The Welsbach Light Pamphlet.

The matter published in our issues of November 28 and December 12, on the "Welsbach Light," universally admitted to be the most complete treatise on the subject thus far published, has been collected in pamphlet form and is now ready for delivery. Every central station man should procure copies for distribution. Price $15 per 1,000 in any quantity. Orders for over 75,000 copies were received in advance of publication.

SOCIETY NEWS.

N. E. L. A.

Following are some of the Papers to be read at the Cleveland meeting of the N. E. L. A., February 19, 20 and 21, 1895: "Some Economies in Electric Light and Power Stations," by Prof. Edward Weston; "Arc Carbons and the National Electric Light Association Standard of Light," by L. B. Marks; "The Monocyclic System," by Dr. Louis Bell; "The Correct Method of Protecting Electric Circuits," by W. E. Harrington; "The Evolution of Arc Lighting Machines," by C. N. Black.

Mr. E. A. Leslie's Paper, read at the Buffalo meeting, and entitled "The Operation of High Tension Currents Underground from a Physical and Financial Standpoint," will be taken up and discussed.

The latter is a topic of vital interest just now, and there should be brought out a discussion of immense value to all members of the association.

Buffalo Electrical Society.

The Buffalo Electrical Society has secured the services of Prof. Albert L. Arey, a member of the New York University Extension Course and Professor of Physics in the Rochester Free Academy, for a course of ten lectures on "Practical Electrical Engineering," to be given at the rooms of the society in Buffalo commencing January 5, 1895, and continuing every alternate Saturday evening until the course is completed.

The course of lectures will be of a practical nature, particularly suited to those who have a knowledge of the rudimentary principles of electricity, and is as follows:

1. "How to Produce Electrical Pressure." 2. "The Electrical Circuit and the Effects of the Current. 3. "The Electro Magnet and its Applications." 4. "Theory of the Dynamo." 5. "Elements of Dynamo Design." 6. "Faults and Ailments of Dynamos, and How to Detect and Remedy Them." 7. "Alternators and Apparatus for Alternating Circuits." 8. "Motors and the Transmission of Power." 9. "Installation Equipments and Methods of Distribution." 10. "Storage Batteries and Chemical Work."

To the members of the Electrical Society and those who will hereafter join the lectures will be free; to those who do not care to become permanently identified with the society a charge of $3 for the entire course will be made. Further information relative to membership in the society and tickets to the lectures can be had of Frank C. Perkins, president, or A. C. Terry, secretary.

Congratulations.

The following announcement repeats again the old, old story of which we never tire:

> Mrs. Margaret F. Hickey announces the marriage of her daughter, Margaret Anna, to Mr. John B. O'Hara, on Thursday, December 27, 1894. Rochester, N. Y.

The fortunate and happy groom has long been a shining light in electrical journalism, and as managing editor of the *Western Electrician* has built up for himself a reputation second to none in the profession. Mr. O'Hara has hosts of friends all over the country who will join with us in the sincerest congratulations over the happy event, and wish the new establishment as great a success in life as the paper over which Mr. O'Hara presides has attained—and even more, if that be possible.

We have always maintained that there was but one fault with the *Western Electrician*, and that was that there were too many eligible old bachelors concerned in its management. Mr. O'Hara is quick to see a point when it is presented, and he has now nobly done his part in removing this stain upon the otherwise bright escutcheon of his enterprising paper. Again ELECTRICITY extends to Mr. and Mrs. O'Hara its sincerest congratulations, and wishes them bon voyage.

LEGAL NOTES.

The Western Electric Company has filed a bill in the United States Circuit Court at Chicago charging the Western Telephone Construction Company with manufacturing and selling electrical devices comprised in the Watson patents for a telephone call and signal apparatus, which the plaintiff company alleges it owns by purchase from the National Bell Telephone Company. An injunction and damages in equity are asked for by the complainant.

An execution has been levied against all the personal property of the Salt Lake and Ogden Gas and Electric Light Company to satisfy a judgment obtained against that company by the Utah National Bank for $16,000.

The St. Louis Electric Power Company has moved to set aside the order of Judge Philips giving judgment for the Edison General Electric Company in the suit brought against it by D. W. Guernsey for commissions due him as Missouri agent of the Sprague Company.

John A. Brill has begun two suits in Philadelphia against the Hestonville, Mantua and Fairmount Passenger Railway Company and the Delaware County and Philadelphia Electric Railway Company for alleged infringements upon patents covering the "Eureka truck," the independent rigid truck, the spring-supported axle-box frame, devices for supporting electric motors, brake mechanism, platform gates, etc.

Obituary.

The many friends of Mr. Frank C. Perkins will be pained to hear of the sad bereavement which has come to him, according to the following announcement: "Pauline H., wife of Frank C. Perkins, of 774 Prospect avenue, Buffalo, N. Y., died December 24th, at 7 o'clock P. M., at the residence of J. W. Perkins, Dunkirk, N. Y." ELECTRICITY extends to Mr. Perkins its heartfelt sympathy in this his hour of darkest trial.

General News.

What is Going on in the Electrical World.

Grand Forks, N. D.—The State University here intend to petition the Legislature for $25,000 for an electric plant.

Chicago.—The Harrison International Telephone Company are considering the question of building a manufacturing plant in this city.

Syracuse, N. Y.—The supervisors' attention has been called to the need of lighting the State Armory by electricity; it is at present lighted by gas.

Marinette, Wis.—The long distance telephone line has been completed to this city and conversation can be carried on with Chicago and New York.

Nyack, N. Y.—There is a plan under way to run a trolley line from Sparkill to Nyack, also from Nyack along the turnpike to the West Shore station.

Albion, N. Y.—A car containing twenty-five persons has been run on Beecher's single rail electric railroad, at Waterford, at a speed of 25 miles an hour a 3 H. P. storage battery being used.

Jefferson City, Mo.—The authorities of Cedar City are trying to induce the Jefferson City Electric Light Company to lay an insulated wire under the river and give Cedar City electric lights.

Houston, Tex.—The Houston General Electric Company, it is said, will soon begin the manufacture of incandescent lamps in connection with the other electrical articles they place upon the market.

Kokomo, Ind. The *Dispatch* states that "a dry battery for use in all electrical alarms has been invented by Godfrey W. Goss of the Laclede Electrical Works. It is said to be a most ingenious and valuable invention."

Cheboygan, Mich.—It is stated that the Cheboygan street railway will change hands soon, and will pass into the possession of Port Huron people. If it does it will be changed to an electric system and will be extended.

Cleveland, Ohio.—The announcement is made that the Consolidated Street Railway Company is to make material improvements in its equipment, among which will be the addition of 40 new motors and 70 new sets of motor equipments.

Greenwood, Ind.—At an election held last week in Pleasant Township, Johnson County, there was a majority of 53 in favor of giving a subsidy of $34,000 to the Franklin, Greenwood and Indianapolis Electric Street Railway to aid in the construction of the road.

St. Paul, Minn.—The United Electric Corporation has applied for a telephone franchise in this city. The headquarters of this company is in Minneapolis. S. Grant, son of Donald Grant, of Faribault, John H. Finney and George H. Kohler are the heads of the concern.

Binghamton, N. Y.—The Binghamton and State Line Railroad Company has begun the construction of a road to connect this city with Williamsport, Pa. The projectors of the road are now considering the advisability of using electricity instead of steam as a motive power.

Detroit, Mich.—The directors of the Detroit Citizens' Street Railway Company have decided to equip their lines with electricity at once.—The police department of this city proposes to establish a telephone plant of its own for service as soon as the Bell Company's contract expires in March.

Indianapolis, Ind.—It is proposed to organize a new telephone exchange here if 1,800 patrons are secured and $200,000 in stock is subscribed. It is said that two-thirds of the requisite number of patrons have been obtained. The instruments of a Chicago company will be used, and the rate will be much less than under the present system.

Toledo, Ohio.—A special to the *Blade* from Caldwell, this State, says that a Cleveland company wants to erect a large manufacturing plant in Caldwell for the manufacture of light dynamos, power motors, power generators, electric cars, including trucks and bodies complete, etc., to have a monthly pay roll of from $2,000 to $5,000.

Islip, N. Y.—The town of Islip has granted the franchise to George B. Studley and A. J. Martin, of Brentwood, to run an electric railroad from Babylon to Bayshore and Islip, thence north to Brentwood and across Long Island through Commack to Northport. Work will be commenced as soon as all the necesssary privileges and rights of ways have been arranged for the purpose.

San Francisco.—The right of way for an electric railway from Merced to the Yosemite Valley is said to have been secured. The capital stock will be $2,500,000. The power is to be established at three points on the Merced River. The road will be broad gauge and will serve the region for freight and passengers like ordinary railroads. The Pacific Improvement Company will take the contract for the construction of the line.

St. Catharines, Can.—It is reported that a company has been formed to build an electric railway between Port Colborne and Fort Erie, Ont., to run along the lake shore and connect with the summer resorts at Fort Erie Beach, Crystal Beach, Point Abino, Lake View Grove and the Solid Comfort, or Humberton Club. Included in the list of projectors of this enterprise are E. Coste, of Buffalo, and Donald McGillivray, of Port Colborne.

Youngstown, Ohio.—Capitalists here, it is alleged, have secured the right of way from farmers for an electric railway from Youngstown to Poland, in the eastern part of the county. Entrance will be secured here by a traffic agreement with the Youngstown electric railway. The new line will be opened during the summer, and the intention is to extend it to New Castle and thence to Pittsburg, making an electric line 70 miles long.

Lawrence, Mass.—There was great rejoicing by the farmers all along the line as the first electric car on the Lawrence and Lowell Railway sped on its way. One old fellow who had been watching for hours for the appearance of the car leaped into the air and waved his arms in a frantic manner so great was his joy. He boarded the car and requested to be taken as far as five cents would carry him. When on the car he plied the motorman with questions as to the motive power and electricity and explained that it was his first ride on an electric car.

Philadelphia.—The directors of the Consolidated Electric Storage Company have declared a quarterly dividend of 1 per cent. from the cash surplus in the treasury, payable January 10. In connection with the declaration of the dividend the directors of the Consolidated Company have announced that all debts, floating and otherwise, including the bonded indebtedness of the company, have been paid and cancelled. This is one of the companies recently absorbed by the Electric Storage Battery Company.

Mantua, N. J.—The first car was run over the Camden, Gloucester and Woodbury electric road extension on Christmas Day, amid the booming of cannon, ringing of church and fire bells and firing of musketry. Every house along the route was decorated with flags and bunting. When the car arrived at this place men, women and children turned out in crowds, and, as the car came to a halt, cheer after cheer rent the air, and the din of the cannons and shotguns gave the affair a regular Fourth of July appearance.

Fostoria, O.—A corps of engineers has completed a special survey of the line for the proposed Tiffin and Fostoria electric road, from Fostoria to Bowling Green. The surveyors met with no obstacles whatever, and the farmers of the district were unanimously in favor of the project. Between Tiffin and Fostoria the grade is all completed and the rails laid part way. The company having secured the necessary funds and assurances of plenty of money, the extension work which was suspended for some time has been resumed.

St. Louis.—The Missouri Pan-Electric Telephone Company, which has shown no signs of life for seven years, has been revived by the decision of Judge Carpenter against the Bell Telephone Company, and a meeting of the stockholders has been called for January 2, when plans for the future work of the corporation will be formulated. The Missouri Pan-Electric Company was organized in 1884 and its speaking contrivances were in constant use in St. Louis between 1884 and 1887. Over 1,000 were in use in the city until March 17, 1887, when the decision of the Supreme Court abolished the system in favor of the Bell.

Dayton, O.—A consolidation of the several electric railroads between Dayton and Cincinnati has been effected. The capital stock of the new company is $500,000, which will be increased as the work on the line progresses. The principal capitalists interested in the deal are Gen. Andrew Hickenlooper, president of the Cincinnati Gas Company; Charles Fleischman, president of the Fleischman Distilleries and Yeast Company; L. C. Weir, president of the Adams Express Company; H. H. Hoffman, tobacconist, Cincinnati; Henry B. Morehead, O. C. Barber, president of the Barber Match Company, and O. B. Brown, representing the Dayton interests of the Dayton Traction Company.

Niagara Falls, N. Y.—The Niagara Falls and Lewiston Railroad, the proposed new electric road to run under the high bank of the gorge close to the water's edge along down past the Whirlpool Rapids, the Whirlpool and Lowe Rapids to Lewiston, is now being pushed forward. The right of way is being contested right and left by propertyowners along the river, and several commissioners have been appointed to take condemnatory proceedings and appraise property. An inspection of the Devil's Hole property and the Niagara Land and Tunnel Company's property has been made by the commission. The company expect to secure the right of way this winter and build the road in the early spring. It will prove a strong scenic rival of the New York Central and the Canadian Electric Road.

Washington, D. C.—Mr. Catchings, of Mississippi, a few days ago, introduced in the House of Representatives his bill to incorporate the National Rapid Transit Railway Company, the concern which proposes to build an elevated railroad between New York and Washington, to be operated by electric motive power, and on which a speed of 120 miles per hour is to be maintained. The bill provides that the road must be equipped with side rails, to prevent derailment and conform to the Brott system of rapid transit railways. The charge for transporting passengers shall not exceed two cents per mile. Construction must begin within three years after the passage of the bill and be completed within two years.—The Metropolitan Railroad Company of this city has mortgaged its railway property for $1,850,000 to the Baltimore Trust and Guarantee Company for the purpose of securing funds to equip its lines with an underground electric system. Work on the new construction will begin in the spring.

Kansas City, Mo.—E. R. Gill, of this city, has invented an electrical machine which promises to automatically perform the duties of the cashier and cash girl or boy in city stores. The apparatus has been tested and worked successfully. It is a combination of wheels, bars of iron, electric wires and tubes. There are as many tubes as there are denominations of money. These tubes are filled with money from which change is made. Beneath the concern is a strong box into which is deposited automatically the cash received from sales. The money is carried to the machine cashier, and the change brought from it over a string in a small tin box. Keyboards or "stations" are placed in different parts of the room. These keyboards look very much like typewriter keyboards. Each key is labelled with a numeral. The purchase money is placed in the traveling tin box. The amount of change required is indicated by pushing in certain keys. By pushing another key the box with the purchase money is started for the machine, and almost at the same moment another box leaves the machine with the exact change therein.

INCORPORATIONS.

The Florissant Avenue Electric Railway Company, St. Louis, Mo.—to construct and operate an electric railway. Capital stock, $2,000. Promoters: E. R. Feuesborn, T. P. Bell, J. H. Schroeder.

The Cincinnati, Hamilton, Middletown and Dayton Street Railroad Company, Cincinnati, Ohio—to construct and operate an electric street railroad between Cincinnati and Dayton. Capital stock, $500,000. Promoters: A. Hickenlooper, Chas. Fleischman, L. C. Weir.

The Poland Railway Company, Youngstown, Ohio—to construct and operate an electric railway between Youngstown and Poland, Ohio—Capital stock, $25,000. Promoters: Gilbert M. Dill, Zebulon P. Curry, Arthur O. Fording, Asael E. Adams, Henry W. Davis.

The Home Heating and Lighting Company, Toledo, Ohio—to produce electricity for heating and lighting, etc. Capital stock, $30,000. Promoters: J. F. Zahm, Homer Yarryan, R. W. Smith, of Toledo.

The Keystone Traction Company, Lancaster, Pa.—to construct and operate motors and cables or other machinery for supplying motive power to passenger railways. Capital stock, $10,000. Promoters: Jno. J. Patterson, Jno. D. Skile, Lancaster; Wm. B. Given, Columbia, Pa.

The Suburban Light, Heat and Power Company, Pittsburg, Pa.—to supply light, heat and power by means of electricity. Capital stock, $5,000. Promoters: Samuel P. Conner, J. W. Patterson, Thos. A. Noble, Pittsburg.

The Winooski Light and Power Company, Winooski, Vt.—to generate electricity by water and other power; furnish light, heat and power to the village. Capital stock, $2,500. Promoters: E. P. Crandall, O. W. Peck, H. F. Wolcott, of Winooski.

The Combination Police and Fire Alarm Company, Chicago, Ill.—to manufacture, vend and sell apparatus actuated by electricity, steam, water or any other kind of motive power, machinery, tools, etc. Capital stock, $1,000,000. Promoters: Chester B. Davis, Wm. H. McAndrews, Roy S. Bates.

The Calumet Construction Company, Chicago, Ill.—to construct buildings, water works, electric power plants, electric light plants, railroads, canals, sewers, etc. Capital stock: $10,000. Promoters: Edw. H. Corse, Jas. W. Burson, Clinton W. Howe.

The Manhattan Alarm Company, New York—to manufacture and sell machinery and mechanical devices, instruments and apparatus for fire alarm and signaling purposes Capital stock, $20,000. Directors: Albert S. Williams, Herbert N. Hansen, William H. Thitchener, John J. Dwyer, Frank and L. Ryan, of New York City.

The Burlington and Mount Holly Electric Railway Company has filed articles of incorporation in the office of the Secretary of State at Trenton, N J. Gen. William J. Sewell, of Camden, is one of the corporators. The road is about seven miles in length, and is now operated as a steam road by the Pennsylvania Railroad Company.

The Greenburg Telephone Company—to construct telephone lines in and between the villages of Hastings, Dobbs Ferry, Irvington and Tarrytown, N. Y. Capital stock, $20,000. Directors: John R. McComb, Henry B. McComb and William A. Jaycox, of Dobbs Ferry; Abraham S. Jackson, of Sing Sing; Edward E. Birdsall, of New Rochelle, Henry O. Reed, of Bath Beach, and Ernest E. Johnson, of New York City.

The Southampton Electric Light Company. Capital stock, $5,000. Directors: Willis D. Van Brunt and H. M. Howell, of Southampton, Suffolk County, N. Y., and Daniel Vail, of Riverhead.

The River and Valley Traction Company—to construct a narrow gauge street surface railroad in Nyack, N. Y. Capital stock, $3,000. Directors: John W. Dalley, C. S. Quidor, Cornelius H. Lydecker, William W. Hinton and others, of Nyack.

The Staten Island Interior Railroad Company—to build and operate an electric road from the ferry landing at St. George through the villages of Tompkinsville, Stapleton and Concord, with a spur to South Beach. Capital stock, $300,000. Directors: Herman Bergholtz, Franklin C. Cornell, Daniel Thomson and DeF. Van Vleet, all of Ithaca, New York; Horace T. Hand, of Scranton, and Alfred Hendriks, of New York City, and Cornelius F. Timpson, Frederick Leuchter and W. J. Creighton, of Staten Island. In addition to these the corporators include Frederick W. Janssen, Frank T. Baumann, W. H. Bostwick and Louis Milani, of Staten Island, and D. T. Evarts, of New York.

The Flushing and College Point Electric Railway Company—to construct and operate a street surface road in and between the villages of Flushing and College Point, N. Y. Capital stock, $125,000. Directors: Daniel Odell, E. Bayard Halstead, Paul D. Cravath, John W. Houston, Victor K. McElheny, Jr., Frank A. Dillingham, Philip F. Kobbe, Harvey Romer and Charles Snow Kellogg, of New York City.

The Tremont Improvement Company, Portland, Maine—to construct electric light, heat and power plants. Capital stock, $1,000. Promoters: Howard L. Rogers, Chas. F. Wallace, Boston, Mass.; Josiah H. Drummond, Jr., Portland.

Woven Wire Brushes.

The Belknap Motor Company of Portland, Me., are the patentees and manufacturers of the best Woven Wire Brush on the market.—[*Adv.*

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED DECEMBER 25, 1894.

ELECTRIC RAILROADS AND APPLIANCES.

531,331. Trolley. Charles E. Powell, Philadelphia, Pa. Filed Oct. 31, 1894.
531,351. Flexible Gear for Electric-Car Trucks. Ferdinand A. Wessel and Ernst Egger, New York, N. Y., assignors of one-fourth to Aaron Naumburg, same place. Filed Sept. 22, 1893.
531,366. Means for Controlling Electric Locomotives. Ernst Egger and Ferdinand A. Wessel, New York, N. Y., assignors of one-fourth to Aaron Naumburg, same place. Filed May 17, 1893.
531,380. Trolley-Catcher. Peter D. Milloy, Buffalo, N. Y. Filed April 2, 1894.
531,383. Trolley. George A. Newhouse, New Albany, Ind. Filed July 28, 1894.
531,437. Trolley-Wire Bracket. Winfield S. Kline, Bolivar, and John B. Westhafer, New Philadelphia, Ohio. Filed Oct. 17, 1894.
531,441. Electric Railway. Charles H. Macloskie, Schenectady, and Henry M. Brinckerhoff, Matteawan, assignors to the General Electric Company, Schenectady, N. Y. Filed May 17, 1894.
531,445. Electrical Connection for Railway-Rails. Arthur J. Moxham, Johnstown, Pa. Filed June 2, 1891.
531,450. Conduit Electric Railway. William H. Swift, Boston, Mass., assignor of one-half to John H. McGrady, same place. Filed April 27, 1894.
531,499. Electric Locomotive for Elevated Railways. Fritz B. Behr, London, England. Filed Feb. 27, 1894.
531,575. Truck for Electric Cars. William Sutton, St. Louis, Mo. Filed Feb. 19, 1894.

ELECTRIC LIGHTS AND APPLIANCES.

531,421. Electric-Lighting System for Railway-Cars. Morris Moskowitz, Newark, N. J., assignor to himself and Leon D. Adler, same place, and A. S. Adler, Philadelphia, Pa. Filed Aug. 10, 1894.
531,422. Electric-Arc Lamp. Edwin J. Murphy, New York, N. Y. Filed Feb. 16, 1894.

DYNAMOS, MOTORS, ETC.

531,365. Controlling Electromagnetic Machines. William I. Donshea, New York, N. Y. Filed Jan. 29, 1894.
531,406 Commutator. Henry L. Bridgman, Blue Island, Ill. Filed July 3, 1894.
531,432. Starting Alternating-Current Motors. Louis Bell, Boston, Mass., assignor to the General Electric Company, same place. Original application filed July 3, 1893. Divided and this application filed March 12, 1894.
531,486. Dredging Machine and Electrically-Actuated Bucket Therefor. Colcord Upton, Salem, Mass. Filed Oct. 15, 1894.

TELEPHONE AND TELEGRAPH APPARATUS.

531,556. Telephone-Index. Charles A. Orth, Trenton, N.J. Filed Sept. 18, 1894.

MISCELLANEOUS.

531,301. Magnetic Ore Separator. Charles G. Buchanan, New York, N. Y. Filed May 12, 1893.
531,310. Electric Cut-Out. Harry Hansen, Everett, assignor of one-half to Nils Olson, Maplewood, Mass. Filed Jan. 23, 1894.
531,354. Electric Conductor Support. Johan M. Andersen, Boston, Mass., assignor of one-half to Albert Anderson, same place. Filed July 9, 1894.
531,423. Insulator. Louis McCarthy, Boston, Mass. Filed Nov. 19, 1894.
531,424. Electric Plug-Switch. Augustus H. Palmer, Utica, N. Y. Filed Oct. 17, 1894.
531,469. Coin-Controlled Game Apparatus. Arthur L. Pratt, Kalamazoo, Mich. Filed Dec. 26, 1893.
531,515. Hinge for Electric Apparatus. Arthur B. Davis, Elkridge, Md. Filed May 12, 1894.
531,614. Electric Cable, Theodore Guilleume, Cologne, Germany. Filed April 26, 1892.
531,617. Automatic Rheostat. Rodolphus W. Hollis, Atlanta, Ga. Filed April 30, 1894.

ELECTRICITY.

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N. E. L. A.—The next annual meeting of the National Electric Light Association will be held at Cleveland, O., February 19-21, 1895. Every concern interested in either lighting or railway work should be represented in the membership of this body, and should have at least one representative at the Cleveland meeting. The Secretary is Mr. Geo. F. Porter, 136 Liberty street, New York.

EDITORIAL NOTES.

Modern Theories as to Electricity. In the January number of the *Engineering Magazine* there appears an article by Prof. Henry A. Rowland on Modern Theories as to Electricity, reproduced on another page, which is likely to attract very wide attention on both Continents for two reasons: first, because anything from Prof. Rowland's pen upon the subject of physics comes with the stamp of highest authority; and second, because since the issue of Prof. Lodge's classical work on Modern Views of Electricity no authoritative expression has been given as to the position of science on this most interesting question. It is but natural, therefore, that in this latest paper great interest should be manifested as to how the views of modern thought have changed.

It is not to be expected that in a magazine article Prof. Rowland could do justice to a subject of such vast import as that of the ether and its various phenomena, nor has he attempted in any instance to go into details. He has been compelled to limit himself to a rather brief summary of what he believes to be our present state of knowledge of the subject, and by this limitation has at times been compelled to sacrifice that perspicuity that would be desirable.

Briefly stated, Prof. Rowland and Dr. Lodge both agree that the theory of electricity and magnetism reduces itself to the theory of the ether and its connection with ordinary matter; but when we come to the mechanism of the ether by which electrical and magnetic phenomena are made manifest, we find a wide divergence between the views of these two gentlemen. For instance, Dr. Lodge assumes a dual quality of the ether, and in summing up says: "We have gradually passed, therefore, from a sort of one-fluid theory to a modified two-fluid theory, believing it to be in some sense or other nearer the truth"; whereas Prof. Rowland says: "There is nothing more certain to-day than that electricity is not a fluid."

Both agree that the ether must account for gravitation, light and heat, as well as for electricity. The usually accepted views of the character of the ether readily explain the phenomena of radiant energy, but gravity has been the stumbling block to all theories. In the propagation of radiant energy the time element is conspicuous, but in gravity it must be absent. Dr. Lodge attempts to show how propagation of gravitation without time is explainable on the theory that the ether is incompressible. He says: "But electrical experiments prove the ether to be enormously—perhaps absolutely—incompressible; and if so, such vibrations as these (those similar to sound vibrations) would travel with infinite speed. Conceivably (I should like to say probably) gravitation is transmitted by such longitudinal impulses or thrusts."

Prof. Rowland, on the other hand, apparently rejects this suggestion as untenable, for he says: "We have absolutely no adequate theory of gravitation as produced by the ether."

The phenomenon of magnetism he believes due to ether vortex rings, which have a material counterpart in the smoke rings with which we are all familiar, and he suggests an explanation of the earth's magnetism on this basis, that the earth's motion creates a vortex in the ether.

Personally there has always appeared to be one difficulty in the vortex theory of magnetism, viz., that it postulates that magnetic energy is kinetic; that it requires a continual expenditure of energy to maintain it. This is true with short electro-magnets; but with closed magnetic circuits, no matter how soft the iron, it has been proved by Ewing and others that the magnetism once imparted is retained indefinitely providing no work is done upon the circuit by which the magnetism is discharged. The case of permanent magnets is a more familiar illustration of our point. It requires the expenditure of energy to impart the magnetism, but when once acquired it is retained indefinitely without further expenditure of energy. The energy is retained—it becomes static. It is capable of doing work just as is the static electric charge or the suspended weight, but involves no expenditure of energy to maintain its potential, as would seem to be implied in the vortex theory. Doubtless Prof. Rowland is right, and our confusion is due to a lack of understanding of the question, for when such men as Rowland, Kelvin, Lodge and others of the same standing hold to a given view we must all rest assured that there is some pretty good foundation for that view. For our own benefit and for the benefit of many of our readers, however, we would like to have this point a little more clearly elaborated.

* * *

The Benefits of Litigation. The Supreme Court of Iowa has just rendered final decision in the Jones County Calf Case, which has been in litigation for twenty years.

In 1874 one Potter came into Jones County to buy calves. He met a former acquaintance, Bob Johnson, who volunteered as a friendly service to go out himself and try and buy some for his old time neighbor. Ten miles from home he met a stranger named Smith, who said he had four calves in a pasture nearby. These were bought and paid for in cash. Johnson took them home to join the larger drove of Potter. A neighbor, Foreman, missed four calves from his herd and claimed those which Johnson had bought of Smith as his property. Johnson believed Foreman's story and gave his note for the price of the calves. Afterwards Johnson became convinced that the four calves bought of Smith were not Foreman's calves, and he refused to pay the notes.

Then Potter and Foreman joined an anti-horse-thief association, which had Johnson indicted for the larceny of the calves. Smith has never turned up and figures as the mythical Smith. Johnson, after several trials, remained unconvicted. Then he began action against seven members of the horse thief association for malicious prosecution. One of the defendants has died and the final action in the Supreme Court was to decide if the remaining six should pay all or only six-sevenths of the costs, Johnson having won his case, with costs. It is held that the six must pay all. The parties are all living now save Harmon Keller, one of the defendants, and the only complaint Bob Johnson makes is that Keller died without his knowledge or consent and without first obtaining an order of court—slipping away from him, he claims, in an unseemly manner. All the participants were prosperous and well-to-do twenty years ago—all are now bankrupt. The calves, and doubtless many of their descendants, have been eaten, the lawyers have taken in $30,000 in fees, the feeling has been so bitter that there has been no decent living in Jones County, and the price of real estate has depreciated one-half. Yet Bob Johnson is vindicated, and in his old age he can philosophize on the benefits of litigation.

The incandescent lamp litigation of electrical companies and nearly all other fights over electrical patents have been as senseless, though perhaps not quite so humorous, as the fight over the four bony calves in Jones County. It has lasted for only ten years, and in that period nearer $6,000,000 than $30,000 has been wasted.

When the Edison patent was finally sustained, in 1891, the price of lamps was 50 cents, as compared to $1 when the litigation began. Then attempts were made to close all competing manufacturers. This latter litigation is still in progress. Meantime there are, and have been every minute since 1891, half a dozen strong competitors in the field; the price has now fallen to 21 cents, and the patent has expired.

The Edison lamp is "vindicated," dozens of lawyers have made independent fortunes, scores of experts have perjured themselves until their consciences are as black as their hats, the profits in the lamp business are reduced to a very close margin, the field is wide open.

Bob Johnson and Mr. F. P. Fish should go down to history yoked together.

Under the Searchlight.

Views and Opinions on Timely Topics.

We extend to Mr. Frederick Nicholls, of Toronto, the compliments of the season in more than a perfunctory manner. In all the columns of revelation in regard to corruption in his city, not one charge was made against him, and he comes out of the affair with no blot on his reputation and no suspicion of wrongdoing.

* * *

Seely to Become an Electrician.

It is said that some time before going into prison, Seely, the defaulter, expressed his desire to learn electrical engineering, and in a day or two he will be put to work in the electrical shops. There, it is said, he can acquire a thorough technical knowledge of electricity, although there will be small opportunity for practical work.

How would it do to give the Warden $1,000 worth of stock and have him establish a branch of the National School of Electricity in the prison?

* * *

Edison and the Patent Laws.

(From the Wheeling Register.)

Edison, the electrician, has long delighted to style the framer of the American patent laws "that Himalayan-Andesian Jackass," but this will hardly cover his latest sentiments now that the Supreme Court of the District of Columbia has decided in favor of the American Graphophone Company against the Edison (or Columbia) Phonograph Company. Substantially this opinion awards the higher honors to Alexander Graham Bell, on the ground that Bell's phonograph cylinders gave a truer value to the instrument than Edison's original tin foil plate. Edison's position is peculiar. The public honors him above all other inventors, but almost all the courts deny and deride his claims.

Our esteemed lay contemporary suggests some vital truths in the above, which will be expressed more at length in the technical papers before many years.

Notwithstanding the work of Dickson and all the other flunkies, Edison's history has not yet been written, his portrait is unpainted. When properly measured, he will still be a great man, but he will not be a god, or even a wizard.

* * *

A reminder of the time when G. E. was paying an 8 per cent. dividend comes to us in the shape of an announcement that the Pennock Electric Company has declared a dividend.

General Electric—Mystery Off.

Continued Misrepresentations of Actual Conditions.

PRESENT STATUS AND FUTURE PROSPECTS.

The clouds which precede the coming storm hang heavy over the Broad street offices of General Electric, the edges thereof reaching as far as Schenectady and Boston. The officers of the company, and the men "who are very close to the management," are kept busy supplying the news agencies and the financial editors with rubbish which means nothing, but which the public are evidently expected to accept as news favorable to the prospects of the organization.

The statements given out are less positive than those of two years ago, but the element of truth is lacking now as it was then.

Does the public ever stop to consider that every statement given out by this company up to sixty days ago has been proved to be false; that every charge made by Electricity has been borne out to the letter?

We are proud of our record in this fight. Electricity was six months in advance of any other publication in the United States in offering criticism, in prophesying failure. When the shares were quoted at 118, we stated that they would sell at 50 before they reached 125. It is our best judgment now that they will sell at 10 before they sell at 40.

And yet, with ruin staring the organization in the face, and close at hand, the game of deception and stockjobbing continues, and not one line of truth in regard to the actual affairs of the company is forthcoming; nothing but rosy statements of great business and "improved" conditions. The same stories were told when the stock was tumbling from 119 to 70; they will still be told undoubtedly when the stock is assessed.

If they had anything affording real encouragement to investors, would they not give out a statement showing gross business for the eleven months of the fiscal year, operating expenses, assets which have increased in value since the marking down of last year, etc., etc.

The following came from one of the news agencies last week:

> It is generally believed in stock circles that the article in to-day's Electricity is the bear attack on the General Electric Company of which rumors have circulated for more than ten days past. One who is recognized as an authority upon G. E. affairs says that the article is grossly exaggerated, and that it does not truly represent the condition of the company. The allegation that the $1,000,000 bonds retired last year were not paid out of earnings is declared to be untrue, as the company now depends upon its earnings rather than new capital for all its expenditures. This has been true ever since the St. Ry. and Ill. Properties issue.

Electricity has no more interest in a "bear attack" on G. E. than it has in the internal troubles of the government of Madagascar.

When we speak, however, of G. E. affairs we speak by the card, and defy contradiction of our charges. If our charges in regard to the retirement of these bonds, *not out of profits*, but out of the sale of treasury assets and the settlement of old accounts are denied, let the G. E. Company publish *now* a list of assets sold during the year, old accounts settled, and explain what they have done with the proceeds.

The facts will not be buried forever.

Electricity can furnish a list of these transactions if necessary.

It is worthy of remark that this inspired paragraph contained no mention of the loss of $2,000,000 of assets through the drawing out of the Ft. Wayne Company, no mention of the $2,000,000 liabilities incurred by the failure of Northwest General Electric, no mention of $8,000,000 patent assets wiped out forever.

Why don't the G. E. officials talk about these things?

Other matter given out last week was as follows:

> General Electric has practically solved the problem of correcting the impairment in its capital stock, which was shown to be over $12,000,000 January 1, 1894. There were $10,000,000 of their 5 per cent. debenture bonds outstanding at that time. It has adopted the policy of employing its surplus to buy in the bonds The amount in round numbers purchased in the year just closing is $1,000,000. The price paid was considerably below the current quotation of 91. The bonds touched 68 in January, and it was understood that the purchases commenced about that time. Should the company be able to get control of a majority of the issue, it would in conjunction with sharp appreciation in the price of its treasury securities, be able to correct the impairment without reducing the capital stock or calling an assessment.
>
> It is generally believed in electric circles that the management has decided to take no action on the impairment of capital beyond buying its own debentures and marking up the value of its treasury assets as they appreciate in value. There was a good deal of opposition to any reduction in the amount of capital stock to meet this impairment, which was practically a bookkeeping impairment rather than an actual impairment. It is reiterated that the best thing the company could have done was done when its own debentures were bought in the market with the profits of the business.

Nothing could show more plainly that the management believe the stockholders and the public to be a pack of imbeciles.

The list of treasury assets was published in April. Since that time there have been two raids upon the G. E. treasury, both made without the knowledge (so it was claimed) of the Board, and some of the best in this list of assets handed over to the Street Railway and Illuminating Properties and to the United Securities Company in exchange for worthless securities sold to these two financiering companies originally.

Moreover, there is not in the entire list any paper which has appreciated or can appreciate in value enough in ten years to make up one-half of the impairment.

No one could speak of marking up the stocks of manufacturing companies (Schedule A) except as a joke.

Of the stocks and bonds of local companies (Schedules B and C) there were on January 31, 1894, par value, $5,536,253.79, carried at $2,718,726.42.

Some have been sold since. The par value of all held to-day is not over $4,500,000. Can they be marked up to three times par value to meet the $12,000,000 impairment?

Dozens of these local properties are in the hands of receivers. Dozens of them owe the G. E. Company large amounts of money, and can't pay interest. Can they be marked up?

A bookkeeping impairment? Certainly it is; and if the bookkeeping were honest the impairment would be $30,000,000 instead of $12,000,000.

Outside of Schedules A, B and C there were carried as assets last year $8,000,000 in patents. Can they be marked up?

There were also notes and accounts receivable of over $8,000,000, many of them from bankrupt local companies. Can they be marked up?

The impairment of the G. E. capital will be corrected in an honorable way only when the stock is wiped out. No one knows this half so well as the bankers and other insiders in the management.

As for correcting this impairment by the retirement of bonds, *it would take at the present rate just twelve years.*

The *Wall Street Daily News* is a great deal nearer correct in its views than most of our contemporaries. It says:

> Notwithstanding the most roseate statements regarding the affairs of the company, very carefully prepared exhibits of earnings showing that dividends have been earned on both classes of stock, heavy purchases of the company's own debenture bonds, and discreetly distributed bull tips on the stock, the price does not advance. . . . A gentleman who is close to the management, and heretofore very correct in his prognostications on General Electric, said yesterday to a representative of the *Wall Street Daily News*, regarding the weakness of the stock:
>
> "I know of no other cause than that those who know most about the company and its affairs do not care to hold any great quantity of the stock. The officials may wriggle as much as they will, and issue whatever statements they like, the fact remains that, sooner or later, the General Electric Company will have to reduce its capital—cut it down one-half. There is no getting away from this, and it explains the weakness of the stock and the disposition manifested to sell it. The person who buys and holds it must consider the fact that it will cost him twice as much as he paid, because in the new arrangement his holdings will be cut in two. As to whether his stock will be worth any more after this is done, I refer him to anyone in the electrical supply and manufacturing line as to whether there is any money in the business. If the person is truthful the answer will be, 'Nary a cent.'"

The directors of this company are in an unfortunate position, to put it very mildly. The longer they evade their duty of giving the full truth to the public the more unfortunate their position will become.

The company was founded upon a fallacy; its policy was an attempt to overturn or ignore the financiering laws of all the centuries of progress. It was foredoomed to failure, and its total collapse is only a question of weeks, not of years.

We believe, and have reason to believe, that the insiders knew of the impending failure in 1892; that they have, every one of them, either unloaded their original holdings upon the public, or made enough money selling stock short at the decline, so that what stock they actually hold has cost them nothing.

The fallacy of the financiering plan has been often pointed out in these columns. The following verbatim copies of letters, written by the president in 1892, show, perhaps more clearly than any comment of ours, the salient points of the scheme; they also show that the directors knew of the dangers in the situation nearly one year before they made public confession by selling the choicest treasury assets to a syndicate at one-half their value, and six months before they allowed a rosy annual report to be issued:

[COPY.]

BOSTON, June 29, 1892.

DEAR SIR: We are really in need of a good class of bonds suitable for our next *Securities Company series*, which we can sell to it at about 70 in cash. I would be glad to have you use every reasonable effort to secure such bonds where you can do so in connection with transactions which will be profitable to your office.

Referring to previous letters which we have written you on this subject, I would say that we can take almost an unlimited amount of bonds providing you get them at *a cost to your office* of not to exceed from 50 *to* 60 *cents* on the dollar. I should be glad to have you look carefully over the business in your territory and advise us as to about how many bonds it is probable that you will be able to turn over to us during the next six months. Yours truly,

C. A. COFFIN.

This letter of advice to agents was written one month after the consolidation.

The phraseology is worthy of careful study. It will be noticed that there is not one word of caution as to the quality of the bonds to be taken. "Transactions which will be profitable to your office" is supposed to be translatable into "transactions upon which you can make a personal profit and divide with your superior officer."

Never mind the actual value of the properties. Give us bonds, bonds, bonds. Give them to us in unlimited quantities at 50 to 60, and we can sell them to the public at 70 to 80. Stand not upon their worth, but give us bonds!

Three months later, the agents having followed instructions, the directors were aware that the scheme had been overworked. The district managers had worked heroically to carry out the orders of their chief. They had taken anything offered in the shape of bonds. They had made money, and the company was on the verge of ruin.

[COPY.]

NEW YORK, Sept. 25, 1892.

MY DEAR SIR: I have just got off the steamer and taken up my mail. I find that some of our new directors, incident to the cholera scare and "*my*" *absence from the country*, have instituted some inquiries with the result of disturbing their minds considerably on the following points:

1. The large stocks of material carried at our different branch offices. This is a proper matter for criticism, and, as you know, we are making every effort to reduce these stocks and I hope we shall have your hearty co operation in reducing by a considerable percentage the stock carried by your office.

2. The large indebtedness of our allied interests, both direct and indirect. This is also a proper matter for criticism, and one to which we should all bend our energies to remedy in every possible way.

3. Taking so many *stocks* and *bonds* in payment for apparatus. This, of course you could anticipate, and while the criticism is honestly made, I think, under all the circumstances of the case, it is possible for us to convince our people that in this respect the action of the company and its branch offices is generally justifiable.

4. The very large amount of salary and general expenses of the various branch offices. This is also a matter concerning which we cannot but feel that there is ground for just criticism. I know that you have done, and in the future promise to do, much to reduce items, and I can only urge you to take all possible steps in that direction.

In order to clear our decks, so to speak, of all our surplus stocks and bonds of local companies prior to our next inventory *I* have conceived the plan of creating a *new pool* of securities, similar to our old Trust securities "A," "B," etc. In order to obtain money readily from our stockholders, it will be necessary to put the securities in at a very low price, the bonds—which we have been carrying in our inventories at 70, at 60, and the stocks at perhaps 20. This method of cleaning up the "cats and dogs" in the inventory of a corporation I think a most *excellent one and a safeguard* against the almost *certain criticism* which will follow any one of our companies which carries a large amount of such securities.

I came home feeling very well indeed, but I am somewhat disturbed at the great accumulation in the hands of the company and the apparent difficulty of obtaining money out of our sales of merchandise. In this connection I would urge you to have it understood in your office that when taking stocks or bonds of local companies the general financing of the company shall be done by the local officers and at local and other banks, so that the current sales to such companies beyond the amounts representing your subscriptions to their bonds shall be on a cash basis. Nothing is more miserable and discouraging than to have the local company in the habit of lying down upon the parent company for current amounts; giving notes and finding themselves unable to meet them at maturity. I beg you to emphasize the need of the greatest care in giving credits, as this matter is also receiving very severe and measurably merited criticism from our new directors. Yours very truly,

C. A. COFFIN.

The financiering was now needed to be done by local banks. New York and Boston had all they required.

How many stockholders of the company were advised in the fall of 1892 that anything whatever was wrong? Were not the public told, even in this very month of September, that the stock was earning 17 per cent. and would soon sell at 150?

The General Electric Company is convicted out of the mouths of its own officers with having been from the first in a dangerous condition.

Every public statement made was false. Every statement issuing now is equally false.

The public no longer want generalities, they demand the truth. What officer of the concern will put himself on record in answer to the following questions:

Have not the treasury assets sold during the year (including notes collected) amounted to more than the notes payable wiped out and bonds retired?

Did not the company lose practically $2,000,000 by the defection of the Fort Wayne Company?

Is it not liable for nearly $2,000,000 as a stockholder in Northwest General Electric?

Is there not a penitentiary job for some one if the affairs of the Northwest Company are ever aired in the courts?

Is it not a fact that the $8,000,000 of patent assets would be marked off the books in any honest company?

Are not half the $9,000,000 of notes receivable claimed in the last report worthless?

Was not the inventory account of last year carried at least $1,000,000 too high?

Could the stocks of manufacturing companies, carried at $2,700,000, be sold for $500,000?

Is there a single article of the company's product on which the price has not been reduced 50 per cent. in two years?

Is a dividend possible for the next twenty years under present conditions of cost, selling expenses and price received?

Will not the next annual report show a further deficit of $6,500,000 at least?

Is not a scaling down of the stock already determined upon, and has it not been delayed only because another scaling down would be equally necessary after January 31 next?

Has it not been determined to make one job of it all?

Has not every member of the Board of Directors sold his original holdings of stock?

Has not the gross business of the company fallen from $20,000,000 to less than $10,000,000, at the same time that selling prices have been reduced one half?

Has not the company paid out within 60 days nearly $70,000 to make good some of its guarantees on stocks and bonds sold to a financing company? What is the extent of the possible liability in this direction?

These and many other questions must be answered, and very soon. The honorable Board can save itself some humiliation perhaps by answering them in advance of an official examination by stockholders.

Eventually these directors may be called upon to explain their individual responsibility for the issuance of two incorrect annual reports.

Direct Application of Flame to Water.

M. Baudsept has read a paper before the Societe Francaise de Physique describing a method of burning oxygen and coal gas, thoroughly mixed, under water or other liquid, so as to apply the heat directly to the lower layers of the liquid with a minimum of waste. He says that 85 and even 90 per cent. of the heat is thus economized. The liquid readily bubbles, and into the hot bubbles the liquid readily boils, so that boiling goes on fiercely even at 85° C. in all parts of the liquid at once. The more perfect the combustion the smaller and more rapid the bubbles in their origin. The apparatus can be used as a calorimeter for the determination of the heating value of coal gas, simply by using the gas to heat up water in the same way, the temperature attained through using a given volume of gas being measured.

The Electropoise.

The Criminals and Their Aids.

Notwithstanding ELECTRICITY's thorough exposure of the fraudulent nature of the Electropoise and of the methods pursued by the Electrolibration Company, the sale of these useless articles still goes on and the public are being swindled out of thousands of dollars daily by the company in its various branches. The fraud, a more vicious one than the sale of green-goods or the old-time confidence game, is being carried on in the best known thoroughfare in the city, the fraudulent circulars flood the mails, and the authorities take no action. More than this, the swindlers are enabled constantly to reach new victims through the publication of their advertisements in such publications as the Brooklyn *Eagle*, the *Churchman*, the *Literary Digest*, the *Review of Reviews*, and many others.

Every one of these publications has been told by authorities that the Electropoise is absolutely fraudulent, a swindle upon the public. Yet they sell their space and reap the financial benefits of a direct share in a criminal business. How can they excuse themselves?

The money received in this way is no more honest money than that secured by the New York police captains for allowing the brothels to exist in their districts. In both cases it is a contribution from criminals to aid them in the commission of further crimes.

There can be no defence. The publications accepting that advertisement confess a willingness to make money by aiding a swindle. Yet the *Churchman* has the hypocritical effrontery to descant upon the evils of the Sunday newspaper:

> "The discussion of the Sunday newspaper at the Church Congress gave much satisfaction to Christians interested in the preservation of the brief hours of the Lord's Day for the development of the spiritual nature of man; and the words of the more seriously minded of the speakers were uniformly devoted to impressing upon churchmen the inevitable loss sustained by those who either neglect divine worship for the attractions of the Sunday newspaper, or attend the services of the church with minds and hearts indisposed by such reading to receive their hallowed influences."

The evils of the Sunday newspaper, however great they may be, would better be pointed out by some paper like the *Sunday School Times*, the *Christian Advocate* of New York, or the *Western Christian Advocate* of Cincinnati, papers whose advertising space is not for sale to promote a fraud, and which can at least come into the discussion of a moral question with clean hands.

We do not know how many other religious papers are still carrying the Electropoise advertisement, but the stain of dishonor and corruption rests on every one of them.

Every legitimate advertiser in any of them would be justified in morals and in law in cancelling his contract unless the advertisements of such frauds are rejected.

ELECTRICITY's exposure was complete; it was verified by men of the highest standing in the medical and electrical professions.

At a trifling expense any publication could make a similar investigation on its own account and get similar proof. But no, these hypocritical, false-teaching journals will continue to accept the money of the criminals as long as they have money and have escaped arrest. When they are finally driven out of business they will withhold all comment on the matter, and wait for another similar swindle to be launched, and assist each succeeding one to filch money from the pockets of their trusting constituents.

"The evils of the Sunday newspaper!" The evils of one church paper like the *Observer* or the *Churchman*, or the others, are more baneful than all the Sunday newspapers ever printed.

Fighting the "Electrical" Frauds.

(From the Scientific Machinist.)

ELECTRICITY, of New York, is a fearless defender of the engineering industries, especially against illegitimate schemes which are carried on in the name of benefaction. It has told the truth—and that only—about the alleged National School of Electricity. In view of the recent developments concerning the management of that school it is time for the police to take a hand.

ELECTRICITY is also waging war against the literary and religious publications which indorse, by the sale of space in their columns for advertising purposes, some of the most barefaced swindles, in the shape of medical goods, which could be devised. The science of electricity has its place in therapeutics, but it is time the gullible public was protected, alike against the electric-healing frauds and the careless and unprincipled editors who assist them.

Away With All Quackery.

To the Editor of ELECTRICITY.

DEAR SIR: I have been too busy to answer your favor of December 1 until now. Of course I am in hearty sympathy with any efforts to put down medical quackery, whether electro-medical or otherwise. There should be some restrictions not only on the sale of bogus electrical appliances for the cure of disease but bogus decoctions which are to be swallowed for the same purpose, as there is very little difference between them in their actual effects so far as the public is concerned. Yours truly,

ELIHU THOMSON.

Lynn, Mass.

Ministerial Indorsements of Humbugs.

(From the Christian Advocate.)

We are sorry to see the names of Christian ministers and persons occupying important positions in the church circulating through the country indorsing barefaced frauds, which are poorly executed and no better than Indian charms. Whenever a minister of the Gospel allows his name to be attached to anything whose advertisements make statements impossible of fulfilment, or contrary to established principles of science, and especially to be mixed up with all sorts of testimonials written obviously by the most ignorant and uncultivated persons, he loses the respect, and justly, of that class of the community which in the long run fixes the estimate in which he is held.

This, together with similar exhibitions of weakness, often accounts for the failure of young men who otherwise give bright promise of success, and the early retirement of those who in spite of them had attained a good standing.

In the interest solely of our readers we advise them to pay no attention to a ministerial testimonial to remedies whose composition is a secret, or which promise positively to cure otherwise incurable or generally fatal diseases. And all the more so if the testimonial contains references to the Almighty and providential direction to buy the medicine. You may be sure then that whatever other effect the remedy has had, it has either weakened or has not improved the condition of the nerve cells upon which sound judgment depends.

When ministers go further and surrender their photographs to patent medicine vendors to be used in advertisements and on bottles, they render themselves liable to one of two suspicions: either that they have an inordinate desire to appear before the public, in which case such ex-

(*Continued on page* 309.)

Popular Electrical Science.

VII.

Signing One's Name a Hundred Miles Away—Signatures That Will Be Recognized by the Banks—Are They Autographs?—The Telautograph.

BY NELSON W. PERRY, E. M.

In the course of invention it not infrequently happens that what are apparently exceedingly complex results are accomplished by astonishingly simple means, and in fact this simplification is what in most cases constitutes invention. What can be more simple, for instance, than the telephone or the phonograph, yet what complexity is involved in articulate speech! At first sight the reproduction, at a distance, of signatures, outline sketches and scrawls which themselves are the results of whims, vagaries or personal characteristics, would seem to involve an intelligence and purpose at the further end in entire consonance with that which gave them birth. How then can these various curves and angles, changing as the mood of the writer changes, defying perhaps all laws of curves or symmetry, be reproduced simultaneously in all their eccentricities at distances comparable with those reached to-day by the telegraph and the telephone? The laws of mechanics come to our aid, and through these, which are but the record of experience, we are taught that any motion, however complex it may be in a single plane, may be resolved into two simple rectilinear motions in the same plane and forming with each other an angle.

An experimental demonstration of the truth of this law may be simply performed as follows:

Supposing we wind upon two spools several turns of flexible cord and attach to these spools a spring so arranged that they both tend to wind more turns of the string, just as the spring curtain rollers tend to wind up the whole curtain when properly freed for the purpose.

Supposing now we attach to the center of this cord a pencil or stylus, and withdraw it to a distance from a straight line which would join the two spools, so that the two portions of the cord on either side of the stylus form an angle whose apex is the stylus. Now if motion of any kind in the plane of the cord be made by the stylus, it will cause the two spools to unwind, or wind up as the point approaches or recedes, and the amount that each spool is revolved will be a measure of the motion involved in the curve which was given in the direction of that part of the cord attached to each spool. If the motion be rapid towards or from either spool, the rapidity of its revolution will also be great, and if the motion in that direction be equal to a turn of the cord or a fractional turn, the spool will revolve in exactly that amount, and in direction according to the direction of motion. An index hand attached to the axis of each spool may be caused to play over a dial graduated into convenient units, such as inches, or feet, or hundredths of a foot, and the amount of such motion may be instantaneously read in the units adopted for measurement. Now, if in making a stroke with the stylus the two spools revolve through certain units adopted, passing through these with certain varying velocities, these same will be invariably repeated both in number and velocity whenever exactly the same stroke is made under similar conditions, or by reversing the stroke, both in extent and in speed, the motions of the index hands will be exactly repeated in an inverse order.

We have thus decomposed the motion of the pen into its two components in directions at an angle with each other. We may also have measured the extent of these two component motions on a dial in units of say hundredths of an inch, and if we have timed these motions, we can exactly reproduce them at any time at a distance, and then and there, by combining them, reproduce again the original motion of which they are components.

We have said that the units of measurement may be anything convenient. Supposing that, instead of a dial marked with lines in ink, say $\frac{1}{100}$ inch apart, we make those lines of metal and connect them all with an electric circuit, so that every time the hand moves over one of these it closes an electric circuit and sends an impulse over the line. Supposing at the other end of the line there be another drum similar in size to the one to which the dial hand and string are attached, and that to this second drum there be fixed also a similar dial marked with teeth just the same distance apart as are the divisions on the first dial. Let there be a spring or weight attached to this second drum, so that it tends to revolve but is prevented from doing so by an escapement which will allow it to revolve but one tooth at a time. Supposing this escapement is actuated by an electro-magnet energized by the impulses sent over the wire, then the second drum will revolve a distance of one tooth every time the dial hand on the first passes over one of the divisions. The second drum would then revolve in exact synchronism with the first, and we have succeeded in transmitting one component of our writing to a distance. Duplicate the apparatus and we have found means of transmitting the other. It now only remains to recompose these two at the further end to reproduce exactly the motions of which they are components. This is accomplished by attaching to each of the further drums two pivoted rigid arms, they themselves being pivoted together at an angle similar to that made by the two strings or cords, and at the apex of this angle place a recording pen or stylus. This latter, actuated by the two drums, will describe in fac-simile and simultaneously all the curves described by the first stylus, and we have made an operative telautograph.

In the pantograph we have a familiar example of the mechanical resolution of forces into their component rectilinear elements and their recomposition again at a short distance into curves similar in every way to the original. In the telautograph the mechanical means of transmission are simply replaced by electrical means, and thus the distances that can be reached are enormously increased.

Many attempts to make this substitute of electrical for mechanical means have been made, but none had met with entire success until Prof. Elisha Gray essayed the task and gave us a practical machine.

It will be impossible within the limits of this article to describe in detail the mechanism by which his results have been attained, but the principles upon which the apparatus is built are those given above.

The writing may be done by an ordinary lead pencil upon ordinary paper. This latter is placed upon a metallic plate which, when slightly pressed upon as when writing, closes an electric circuit which brings the transcribing pen at the further end down upon the paper upon which the message is being received. So long as the pencil presses upon this plate, so long will the receiving stylus describe fac-simile evolutions in contact with its paper and leave a record thereon, but if the transmitting pencil be raised as for dotting an *i*, crossing a *t*, or in beginning a new word or a new line, the receiving stylus will leave the paper also and perform the remainder of its evolutions in the air until the pressure of the pencil again closes the circuit when it will begin to write again as before.

In this way an area of paper five inches wide by three or four inches deep may be covered with writings or inscriptions of any kind before shifting is necessary. When this space has been covered, and it is desired to continue the letter or message, the paper in the transmitter is moved upward over the plate by a step-by-step mechanical movement very similar to that employed on the typewriter when a new line is to be commenced. This mechanical movement sends electrical impulses over the line to the receiving instrument which reproduce the mechanical step-by-step movement in the latter, and thus the receiving paper is moved forward an exactly similar distance and the spacing of the lines will be the same in both the original and in the received message.

The received message is thus almost a fac-simile of that sent both as to size and spacing of the letters and lines and as to the characters of the curves involved. The receiving pen, however, is a glass tube drawn out to capillary dimensions and incapable of shading the lines, even if provision were made for varying its pressure similarly to the varying pressure of the transmitting pen. The characteristics of a signature, among the most prominent of which is often the peculiar method of shading the letters, are therefore not reproduced with exact fidelity, and it is a question whether a signature thus transmitted would be good in law or not.

How important this shading is in some cases will be manifest by recalling the signature of Mr. Spinner, formerly Register of the Treasury, with which we were all more or less familiar. No one could make out what the signature was unless told beforehand, yet those oddly shaded hieroglyphics had a charm for all of us that compelled recognition even though their true purport was not understood. Would any of us have recognized as the same that same signature bereft of its shading?

However, the reproduction is exceedingly good, and many of the other characteristics of handwriting are preserved with sufficient accuracy to enable us to recognize the chirography of friends, and this is a great advancement over anything previously accomplished in this line.

It is understood that it is the intention of the owners of the telautograph to establish exchanges similar to the present telephone exchanges, through whose agency subscribers may be put into communication with one another. In the telephone exchange it is possible for a person properly located to hear all the conversation that passes between subscribers. Those who are talking, therefore, do it with the consciousness that they are at least liable to be overheard, and strictly confidential communications of great importance are therefore entrusted to the telephone with some misgivings and some risk. The same is true with the telegraph, but with the telautograph no such thing is possible. The subscriber may have his instrument under lock and key and the message, even though it pass through a central exchange, is inviolate. By this means the most confidential communications may be with entire safety entrusted to the wires, and it is the *only* means thus far invented that seems to fully answer this bill.

The telautograph, however, requires four wires for its proper operation, and this would seem to militate largely against its general introduction. It is necessarily an expensive instrument to install, and it does not seem possible that its rental can be reduced to a figure that will meet the popular demand. In these ways the telautograph seems to be heavily handicapped. There is a field for it, however, as for instance in the railroad business where the wires for telegraphic purposes are already strung and where four lines could be diverted to this purpose when required. The superintendent could in this way send autographic orders to the station agents along the road. In this case it would seem that written records of such orders should be required and if they be exact fac-similes of autographs so much the better. It would seem that in this and similar applications the telautograph has a field already awaiting it.

MODERN THEORIES AS TO ELECTRICITY.*

BY HENRY A. ROWLAND.

It is not uncommon for electricians to be asked whether modern science has yet determined the nature of electricity, and we often find difficulty in answering the question. When the latter comes from a person of small knowledge which we know to be of a vague and general nature, we naturally answer it in an equally vague and general manner; but when it comes from a student of science anxious and able to bear the truth, we can now answer with certainty that electricity no longer exists. Electrical phenomena, electro-static actions, electro-magnetic actions, electrical waves—these still exist and require explanation; but electricity, which, according to the old theory is a viscous fluid throwing out little amœba-like arms that stick to neighboring light substances and, contracting, draw them to the electrified body, electricity as a self-repellant fluid or as two kinds of fluid, positive and negative, attracting each other and repelling themselves—this electricity no longer exists. For the name electricity, as used up to the present time, signifies at once that a substance is meant, and there is nothing more certain to-day than that electricity is not a fluid.

This makes the task of one who attempts to explain modern electrical theory a very difficult one, for the idea of electricity as a fluid pervades the whole language of electrical science, and even the definitions of electrical units as adopted by all scientists suggest a fluid theory. No wonder, then, that some practical men have given up in despair and finally concluded that the easiest way to understand a telegraph line is to consider that the earth is a vast reservoir of electrical fluid, which is pumped up to the line wire by the battery and finally descends to its proper level at the distant end. Is not this the proper conclusion to draw from that unfortunate term "electric current?" Remembering this fact—that we cannot yet free ourselves from these old theories and exactly suit our words to our meaning—we shall now try to understand the modern progress in electrical theory.

This whole progress is based upon something in the human mind which warns us against the possibility of attraction at a distance through vacant space. Newton felt this impossibility in the case of gravitation, but it is to Faraday that we must look principally for the idea that electrical and magnetic actions must be carried on by means of a medium filling all space and usually called the ether. The development of this idea leads to the modern theory of electrical phenomena.

Take an ordinary steel magnet and, like Faraday, cover it with a sheet of paper, and upon this sprinkle iron filings. Mapped before us we see Faraday's lines of magnetic force extending from pole to pole. We can calculate the form of these lines on the supposition that a magnetic fluid is either distributed over the poles of the magnet or on its molecules, assuming that attraction takes place through space without an intervening medium. But at this idea the mind of Faraday revolted, and he conceived that these lines, drawn for us by the iron filings, actually exist in the ether surrounding the magnet; he even conceived of them as having a tension along their length and a repulsion for one another perpendicular to their length.

Two magnets, then, near each other, become connected by these lines, which, like little elastic bands always pulling along their length, strive to bring the magnets together. These so called lines of force (now called tubes of force) were, by his theory, conducted better by iron and worse by bismuth than by the ether of space, and so gave the explanation of magnetic attraction and diamagnetic repulsion.

The same theory of lines of force was also applied by Faraday to electrified bodies, and thus all electrostatic actions were explained. By this idea of lines of force it will be seen that Faraday did away with all action at a distance and with all magnetic and electrical fluids, and substituted instead a system in which the ether surrounding the magnet or the electrified body became the all-important factor and the magnet or electrified body became simply the place where the lines of force ended: where a line of magnetic force ended there was a portion of *imaginary* magnetic fluid; where a line of electric force ended there was a portion of *imaginary* electric fluid. As the quantities of so-called plus and minus electricity in any system are equal, we can thus imagine every charged electrical system to be composed of a group of tubes of electrical force (more strictly electric induction) which unite the plus and minus electrified bodies, each unit tube having one unit of plus electricity on one end and one unit of minus electricity on the other. The tension along the tube explains the reason why such an arrangement acts as if there were real plus and minus electrical fluids on the ends of the tube, attracting one another at a distance. Consider a plus electrified sphere far away from other bodies. The lines of force radiate from it in all directions, and being symmetrical around the sphere, they pull it equally in all directions. Now bring near it a minus electrified body, and the lines of force turn toward it and become concentrated on the side of the sphere toward such a body. Hence the lines pull more strongly in the direction of the negative body and the sphere tends to approach it.

In the case of a conducting body the lines of force always pass outwards perpendicularly to the surface, and hence, if we know the distribution of the lines over the surface, or the so-called surface density of the electricity, we can always tell in which direction the body tends to move. It is not necessary to know whether there are any attracting bodies near the conductor, but only the distribution of the lines. These lines then do away with all necessity for considering action at a distance, for we only have to imagine a kind of ether in which lines of force with given properties can exist and we have the explanation of electric attraction.

But the question now arises as to how the lines of electric force can be produced in the ether, or, in other words, how bodies can be charged.

In the first place we know that equal quantities of plus and minus electricity are always produced. As an illustration, suppose it is required to charge two balls with electricity. Pass a conducting wire between them with a galvanic battery in its circuit. The galvanic battery generates the lines of force; these crowd together around it and push each other sideways until their ends are pushed down the wire and many of them are pushed out upon the balls.

When the tension backwards along the lines of force just balances the forward push of the electromotive force of the battery, equilibrium is established. If the wire is a good conductor, there may be electrical oscillations before the lines come to rest in a given position, and this I shall consider below.

The motion of the ends of the lines of force over and in the wire constitutes what is called an electric current in the wire which is accompanied by magnetic action around it and also by waves of electro-magnetic disturbance which pass outward into space.

If, after equilibrium is established, we remove the wire, we have simply two charged spheres connected by lines of electrostatic force and thereby attracted to each other. If we replace the battery by a dynamo or by an electric machine the effect is the same.

But there is another way by which bodies are often charged and that is by *friction*. In this case we can suppose the glass to take hold of one end of the lines of force and the rubber the other end and it is then only necessary to pull the bodies asunder to fill the space with lines. The friction is merely needed to bring the two bodies into intimate contact and remove them gently from each other.

The following considerations may guide us in understanding the details of the process. It is well known from Faraday's researches that a given quantity of electricity has a fixed relation to the chemical equivalents of substances. Thus it requires 10,000 absolute electromagnetic units of electricity to deposit 114 grams of silver, 68 grams of copper, 34 grams of zinc, etc.

Hence we can consider, for instance, in chloride of silver that the atoms of silver are joined to the atoms of chlorine by lines of electrostatic force which hold them to each other. If, by rubbing the chloride of silver, we could remove the chlorine on the rubber while leaving the silver, we could stretch them asunder and so fill space with the lines of electrostatic force. According to this theory, then, each atom has a number of lines of force attached to it, and it is only by stretching the atoms apart that we can fill an appreciable space with them and so cause electrostatic action at a distance.

We come to the conclusion, then, that all electrification is originally produced by separating the atoms of bodies from one another, which can be done by breaking contact, by friction, or by direct chemical action of one substance on another, or in some manner not so common. The lines of electrostatic force in a case of electricity at rest must always begin and end on matter, and they can never have their ends in space free from matter. The ends can be carried along with the matter, constituting electric convection, or they can slide through a metallic conductor or an electrolyte or rarefied gas, making what we call an electric current; but as they cannot end in a vacuum they cannot pass through it. Thus we conclude that a vacuum is a perfect non-conductor of electricity.

The exact process by which the ends of the lines of force pass through and along a conductor can at present be only dimly imagined, and no existing theory can be considered as entirely satisfactory. In the case of an electrolyte, however, we can form a fairly perfect picture of what takes place as the decomposition goes on. Thus, in the case of zinc and copper in hydrochloric acid, we can imagine the zinc plate attracting the chlorine of the acid, thus stretching out the natural line of electric force connecting the chlorine atom and the first hydrogen atom; we can imagine the atoms of chlorine and hydrogen in the body of the liquid recombining with each other and their lines of force uniting until they form a complete line long enough to stretch from the zinc to the copper plate; and all without once making a line of force without its end upon matter. We can further imagine the ends of this line sliding along the copper and zinc plates to the conducting wires and down their length, thus making an electric current and carrying the energy of chemical action to a great distance.

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* *Engineering Magazine.*

If the ends of the lines should slide along the wire without any resistance, the wire would be a perfect conductor; but all substances present some resistance, and in this case heat is generated. This we always find where an electric current passes along a wire. As to the exact nature of this resistance or the nature of metallic conduction in general we know little, but I believe we are approaching the time when we can at least imagine what happens in this most interesting case.

Besides the heating due to the electric current, steadily flowing, we must now account for the magnetic lines of force surrounding the current and the magnetic induction of one current on the other.

If the current is produced by the ends of the tubes of electrostatic force moving along the wire, then we may imagine that the movement of the lines of electrostatic force in space produces the lines of magnetic force in a direction at right angles to the motion and to the direction of the lines of electrostatic force. At the same time we must be careful not to assume too readily that one is the cause and the other the effect: for we well know that a moving line of magnetic force (more properly induction) produces, as Faraday and Maxwell have shown, an electric force perpendicular to the magnetic line and to the direction of motion. Neither line can move without being accompanied by the other, and we can, for the moment, imagine either one as the cause of the other. However, for steady currents, it is simpler to take the moving lines of electrostatic force as the cause and the magnetic lines as the effect.

We have now to consider what happens when we have to deal with variable currents rather than steady ones.

In this case we know from the calculations of the great Maxwell and the demonstrations of Hertz that waves of electromagnetic disturbance are given out. To produces these waves, however, very violent disturbances are necessary. A fan waved gently in the air scarcely produces the mildest sort of waves, while a bee, with comparatively small wings moved quickly and vigorously, emits a loud sound.

So with electricity, we must have a very violent electrical vibration before waves carrying much energy are given out.

Such a vibration we find when a spark passes from one conductor to another. The electrical system may be small in size, but the immensely rapid vibrations of millions of times per second, like the quick vibration of a bee's wing, sends out a volume of waves that a slowly moving current is not capable of producing. The velocity of these waves is now known to be very nearly 300,000 kilometers per second. This is exactly the velocity of waves of light or other radiation in general, and there is no doubt at present in the minds of physicists that these waves of radiation are electromagnetic waves.

By this great discovery, which almost equals in importance that of gravitation, Maxwell has connected the theories of electricity and of light, and no theory of one can be complete without the other. Indeed they must both rest upon the properties of the same medium which fills all space—the ether.

Not only must this ether account for all ordinary electrical and magnetic actions, and for light and other radiation, but it must also account for the earth's magnetism and for gravitation.

To account for the earth's magnetism, we must suppose the ether to have such properties that the rotation of ordinary matter in it produces magnetism. To account for gravitation it must have such properties that two masses of matter in it tend to move toward each other with the known law of force, and without any loss of time in the action of the force. We know that moving electrical or magnetic bodies require a time, represented by the velocity of light, before they can attract each other in the line joining them; but for gravitation no time is allowable for the propagation of the attraction.

But the problem is not so hopeless as it at first appears. Have we not in two hundred and fifty years ascended from the idea of a viscous fluid surrounding the electrified body and protruding arms outward to draw in the light surrounding bodies to the grand idea of a universal medium, which shall account for electricity, magnetism, light and gravitation?

The theory of electricity and magnetism reduces itself, then, to the theory of the ether and its connection with ordinary matter, which we imagine to be always immersed in it. The ether is the medium by which alone one portion of matter can act upon another portion at a distance through apparently vacant space.

Let us then attempt to see in greater detail what the ether must explain in order that we may, if possible, imagine its nature.

1st. It must be able to explain electrostatic attraction. These electrostatic forces are mostly rather feeble as we ordinarily see them. Air breaks down and a spark passes when the tension on the ether amounts to about $\frac{1}{100}$ pound to the square inch. It is the air, however, that causes the break-down. Take the air entirely away, and we then know no limit to this force. In a suitable liquid it may amount to 500 times that in air, or 5 pounds to 1 square inch, and become a very strong force indeed. In a perfect vacuum the limit is unknown, but it cannot be less than in a liquid, and may thus possibly amount to hundreds, if not thousands, of pounds to the square inch.

2d. It must explain magnetic action. These actions are apparently stronger than electrostatic actions, but in reality they are not necessarily so. A tension on the ether of only a few hundred pounds on the square inch will account for all magnetic attraction that we know of, although we are able to fix no limit to the force the ether will sustain. No signs have ever been discovered of the ether breaking down.

Again, we must be able to account for the magnetic rotation of polarized light as it passes through the magnetic field; and it can only be accounted for by assuming a rotation around the lines of magnetic force. This action, however, takes place only while the lines of magnetic force pass through matter, and it has never been observed in the ether itself. The velocity of rotation, however, is immense, the plane of polarization rotating in some cases 300,000,000 times per second.

The ether must also account for the earth's magnetism. If we assume that magnetic lines of force are simply vortex filaments in the ether, we have only to suppose that the ether is carried around by the rotation of the earth, and we have the explanation needed. The magnetism of the earth would then be simply a whirlpool in the ether.

3d. The ether must be able to transmit to a distance an immense amount of energy either by means of electromagnetic waves in light or by the similar action which takes place in the ether surrounding a wire carrying an electric current.

The amount of energy which can be transmitted by the ether in this manner is enormous, far exceeding that which can be carried by anything composed of ordinary matter. Thus take the case of sunlight: on the earth's surface illuminated by strong sunlight a horse-power of energy falls on every seven square feet. At the surface of the sun the ethereal waves carry energy outward at the rate of nearly 8,000 horse-power per sq. foot!

Again, an electric wire as large as a knitting needle, surrounded with a tube half an inch in diameter in which a perfect vacuum has been made to prevent the escape of electricity, may convey to a distance a thousand horse-power, indeed even ten thousand or more horse power, there being apparently no limit to the amount the ether can carry.

Compare this with the steam engine, where only a few hundred horse-power requires an enormous and clumsy steam pipe. Or, again, the amount carried by a steel shaft, which, at ordinary rate of speed, would require to be about a foot in diameter to transmit 10,000 horse power.

When we compare the energy transmitted through a square foot of ether in waves, as in the case of the sun, with the amount that can be conveyed by means of sound waves in air or even sound waves in steel, the comparison becomes simply ridiculous, the ether being so immensely superior. As quick as light, the ether sends its wave energy to the distance of a million miles, while the sluggard air carries it one. Thus, with equal strain on each, the ether carries away a million times the energy that the air could do.

4th. The ether must account for gravitation. For this purpose we are allowed no time whatever to transmit the attraction. As soon as the position of two bodies is altered, just so soon must the line of action from one to the other be in the straight line between them.

If this were not so, the motion of the planets around the sun would be greatly altered. Toward the invention of such an ether, capable of carrying on all these actions at once, the minds of many scientific men are bent. Now and then we are able to give the ether such properties as to explain one or two of the phenomena, but we always come into conflict with other phenomena that equally demand explanation.

There is one trouble about the ether which is rather difficult to explain, and that is the fact that it does not seem to concentrate itself about the heavenly bodies. As far as we are able to test the point, light passes in a straight line through space even when near one of the larger planets, unless the latter possesses an atmosphere. This could hardly happen unless the ether was entirely incompressible or else possessed no weight.

If the ether is the *cause* of gravitation, however, it is placed outside the category of ordinary matter, and it may thus have no weight although still having inertia—a thing impossible for ordinary matter where the weight is always exactly proportional to inertia.

Ether, then, is not matter, but something on which many of the properties of matter depend.

It is curious to note that Newton conceived of a theory of gravitation based on the ether, which he supposed to be more rare around ordinary matter than in free space. But the above considerations would cause the rejection of such a theory. We have absolutely no adequate theory of gravitation as produced by the ether.

To explain magnetism, physicists usually look to some rotation in the ether. The magnetic rotation of the plane of polarization of light together with the fact of the mere rotation of ordinary matter, as exemplified by the earth's magnetism, both point to rotation in the ether as the cause of magnetism. A smoke ring gives, to some extent, the modern idea of a magnetic line of force. It is a vortex filament in the ether.

Electrostatic action is more difficult to explain, and we have hardly got further than the vague idea that it is due to some sort of elastic yielding in the ether.

Light and radiation in general are explained when we understand clearly magnetic and electrostatic actions, as the two are linked together with certainty by Maxwell's theory.

Where is the genius who will give us an ether that will reconcile all these phenomena with one another and show that they all come from the properties of one simple fluid filling all space, the life-blood of the universe—the ether ?

The Legal Status of Electric Wires in the Streets.

BY R. D. FISHER.

The principles governing the use of streets and the powers and duties of cities regarding the multiplicity of wires have been the subject of recent consideration by the public press, but with little or no regard for the legal relation of the wires to the streets. It is a primary fact that the legal relation of these wires to the streets depend almost wholly upon whether such use serves the purposes for which the streets are opened, and whether they interfere with the uses for which the streets have been commonly maintained.

In respect to municipal corporations, which at present seem burdened with the task of adjustment, the question arises whether any special authority is required for making such use of the streets, and if so, from whence and how is the permission derived and obtainable. In the very recent agitation of the question, many cities are tarrying on the threshold of the query as to whether such public rights in the streets are vested in a municipal government or in the Legislature of the State. If the power to permit a new use of the street must come from the Legislature, is it included in the ordinary powers delegated to city corporations, and, in particular, the uses for which cities and towns may grant the privilege of stringing wires in the public streets ? Passing the question of the power to impose license or taxes, the immediate question of concern is whether wires once put up under municipal license may be removed by authority of the city, or on what terms removed by a Legislature ? By what authority may wires be ordered taken down and placed underground, and by what authority may subway rights be regulated, are questions suggested by the demands of the hour. The cases decided with special reference to electric wires are not very numerous, but sufficient to develop a branch of the law in respect to electric wires. The relation of the street to the abutting property owner, and his rights in the street, are all involved in the agitation. While doubts have been expressed by recent decisions with regard to distinctive rights, courts are slowly but surely recognizing clearly the right of access of light and air, and other privileges necessary in an emergency to an unrestricted right of adjacency to property. There are many questions incidental to this subject which, on account of the great weight and multiplicity of wires, have attracted attention, among them the liability for injuries sustained by reason of unlawful or unnecessary obstruction, or by reason of negligence in constructing and operating electric wires. Precautions necessary to avoid accident or injury against violent storms, dangerous and deadly currents, and interference in case of fire, are subjects that burden the companies more and more as municipalities and legislatures take a turn at the wheel of legal regulation.

Assuming, therefore, that the same principles apply to electric wires as to other uses or easements in the streets, we conclude from a careful examination of the authorities that it is well settled that the use of the streets belongs to the public at large, that the State Legislature represents the public, and that a municipality has no control over the streets other than that given it by legislation, either expressed or implied. (See 35 N. J.L., 208 ; 6 Whart., 25.)

In the absence of any restraint in a State constitution, the Legislature has full and paramount authority over all public streets and public places. (See Dill. Mun.Corp., 4th ed., sec 657, and numerous cases cited.)

Thus it is fair to presume that the authority of cities over streets and the uses for electric wires depend wholly upon their charters or the legislative action concerning such uses. (See 49 N. J. L., 344; 115 U. S.. 650, 683, 674; 55 Conn., 1; 6 Oregon, 62; 39 N. J. Eq., 366. For modification, see 44 N.J. Eq., 427; 29 Wis., 454). (In this connection it is held that a city has no right to grant an exclusive property interest in the streets and such grant is void as a monopoly—28 Conn., 19). The power of a city is therefore limited in the respect of electric wires to the breadth of the charter or statutes authorizing municipal action. This brings attention to the growing importance of the modern question as to whether an indefinite number of wires are to longer remain strung over and through the streets, or be placed in subways of convenient capacity and practical use. Legislative authority has been granted to cities in a few States to regulate the use of wires in the streets, and it is the reputed intention of a number of State Legislatures to consider the question during the present sessions. The necessity for such legislation is due to the number of cities that have ordinances pending to regulate the use and position of electric wires for whatsoever use. The need of such an ordinance in many cities has been discussed and demanded on account of the numerous fires due to defective wires and the resistance to effective and safe work of the fire department in efforts to extinguish fires. Distressing accidents to man and beast, due in some cases to negligent construction, or by reason of storms, are also potent causes creating a demand for power to compel the placing of wires beneath the surface. At most, all that can be exacted of electric companies rightfully maintaining wires in a street is that they shall properly construct and maintain them. They are not insurers of the safety of the street against injury from their poles and wires. So long as wires are permitted to remain strung in the streets the companies are not bound to guard against storms of unusual severity (71 N.Y., 81), and accidents due to such climatic influences are not chargeable to electric companies unless due to negligence, and the amount of care required need only be proportioned to the amount of danger and the liability to accident. Upon the several points, we subjoin the following duties incumbent upon electric companies as construed by our courts :

While not insurers of the safety of the street to the travelling public, they are bound to see that the lines of wire are properly constructed and maintained (71 N. Y., 81).

Must remove wires immediately when fallen into the street, though fall be due to causes beyond their control (33 Minn., 430). A municipal corporation has power to regulate the placing and maintenance of poles and wires in the streets (16 Fed. R., 309.)

Municipal authorities have no right to molest the wires of an electric company suspended on private property though strung across the street, so long as they do not interfere with the free use of the streets for purposes of travel (31 N. J. Eq., 627).

As to the reciprocal rights of two companies maintaining electric wires in streets, courts will restrain one from so placing or using its wires as to injure the other (14 Cinn. Law Bulletin, 327).

According to decisions in Illinois, the erection of wires in a street imposes a new burden for which the abutting property owner is entitled to compensation (107 Ill., 507).

Chap. 109 Pub. Stat., Mass., provides for the stringing of wires in streets for public use, but makes no provision for compensation to abutting owners (186 Mass., 75).

In Missouri the erection of wires in the streets with the consent of the municipal authorities is a proper use under a dedication for street purposes, and the abutting owner becomes entitled to no additional compensation by reason of such wires if erected in a skilful and proper manner (88 Mo., 258).

A contrary view is taken in New York. The maintenance of wires is not a use of the streets of the city of New York (when a fee exists for street uses only) which the Legislature has a right to authorize without compensation to abutting owners (50 N. Y. Supr., 489); *contra* (see 65 Howard Pr., 407).

Electric wires impose new burdens, and abutting owners must consent to and be compensated for their erection according to an Ohio court (9 Cinn. Law Bulletin, 65).

Street uses are not confined to those known at the time of the dedication of land for streets, but include such as are subsequently discovered or invented; and where damages grow out of such new use of a street by use of wires they must be certain, not speculative or contingent (88 Mo., 258).

Prof. Helmholtz's Successor.

Dr. Friedrich Kohlrausch, Professor of Physics at Strasburg University, has been offered and has accepted the position of Director of the Physico-Technical Institute in Berlin, in succession to the late Prof. Helmholtz.

Dr. Kohlrausch, who has thus been called to succeed the most eminent physicist of this age, seems to be the one upon whom the mantel would most naturally descend.

Friedrich Kohlrausch, Ph. D., was born in 1840, at Rinteln, on the Weser. His father, Rudolf Kohlrausch, was the constructor of the first instrument for the measurement of low potentials. He afterwards made measurements of contact potentials and gave the first experimental demonstration of Ohm's law. From 1850 to 1858 the father taught at the Polytechnic School at Cassel and at the Universities of Marburg and Erlangen, and it was at these places that the son received his education. Even at this early age he was allowed to assist his father in many of his investigations, for example, in those concerning the electric residual charge. He also helped in preparing for the measurements made jointly by his father and Wilhelm Weber, particularly in the first comparison of the electromagnetic with the electrostatic unit or the velocity "*v*" in Maxwell's theory. The father died in 1858, the year in which Friedrich entered the university. The latter studied physics under Beetz in Erlangen, but the greater part of his work was done under Wilhelm Weber in Göttingen. Here he received in 1863 the degree of Ph.D., having as the subject of his dissertation the elastic after-effect. For a short time after this he held the position of assistant in the Göttingen Astronomical Observatory. From 1864 to 1866 he was instructor in physics in the Physikalischer Verein at Frankfort-on-the Main, and then returned to Göttingen to become Weber's assistant; he was also made privat docent and professor extraordinarius. From 1870 to 1871 Kohlrausch was professor in the Polytechnicum at Zürich, and from 1871 to 1875 in that of Darmstadt. He was then called to the University of Würzburg, where in 1879 a new physical laboratory was erected according to his plans. In 1888 he became professor at the Kaiser Wilhelm's University of Strasburg, which posi tion he now holds. As a teacher Kohlrausch has always laid especial emphasis on the importance of practical physics. The first systematic course of instruction in this department he organized at Weber's suggestion in Göttingen in 1867. From this originated in 1869 his "Leitfaden der praktischen Physik," the pioneer among works of its kind. Besides the six German editions of this book there have appeared two English editions of a translation by Waller and Procter, and it has also been translated into French, Russian and Hungarian. In reviewing briefly Kohlrausch's more important contribution to science, special mention should be made of his work on elasticity, embracing a series of investigations concerning the elastic after effect and the influence of temperature. He has also successfully applied the the principle of total reflection to optical measurements. But the greater number of his scientific investigations refer to electricity and magnetism; they introduce new methods and new instruments for the observation and absolute measurement of the periodic and local variations of the earth's magnetic force; also for the absolute measurement of electrical current strength and resistance for scientific or technical purposes. These methods have been applied by Kohlrausch in his determination of the electro chemical equivalent and to the absolute electrical resistance of mercury ("Determination of the Ohm"). For the measurement of the resistance of electrolytes he introduced alternating currents, using as an instrument of observation the dynamometer or the telephone. By means of this delicate method he has conducted numerous investigations concerning the conductivity of water and aqueous solutions of electrolytes; he has investigated the electromotive force of very thin gas films on the electrodes, and established the validity of Ohm's law for electrolytes. He has published theoretical investigations on the movement of the electrolytic ions, and on thermo-electricity. His writings have been published in the *Annalen der Physik und Chemie* of Poggendorff and Wiedemann, in the *Electrotechnische Zeitschrift*, and in the publications of the Berlin, Göttingen and Munich Academies.

SOCIETY NEWS.

N. E. L. A.

The Central Traffic Association have granted the application of the N. E. L. A. for excursion rates to the Cleveland meeting. The rate from all points in their territory to Cleveland will be a fare and one third, on the certificate plan, for the round trip. The other associations will undoubtedly concede the same rate.

The A. I. E. E. and the Ottawa Winter Carnival.

Mr. T. Ahearn, managing director of the Ottawa Electric Railway and a member of the American Institute of Electrical Engineers, in behalf of the Carnival management extends a hearty invitation to his fellow members and their friends to visit Ottawa, Ont., during the week of the Grand Winter Carnival, January 21 to 26.

The many attractive features of the Canadian capital city are well known to travelers, and Ottawa is generally recognized as the electrical headquarters of the Dominion.

Concentrating Sulphuric Acid by Electricity.

The concentration of sulphuric acid has recently been effected electrically. Heaters consisting of coils of platinum wire are suspended in the acid and a current is passed through. The method, under suitable conditions, is said to be very convenient. It is due to Messrs. Johnson and Matthey, of London, England.

THE ELECTROPOISE.

(*Continued from page 304.*)

travagant vanity must weaken their influence; or that they have received a compensation for the privilege. For that quacks of all sorts are ready to pay largely for certificates from physicians, for editorial notices, and for the privilege of publishing letters from and photographs of clergymen, cannot be doubted.

Not only do they thus render themselves liable to suspicion, but they grieve every truly refined member of their congregations, and every member, in fact, of their denomination who sees their pictures and letters displayed for such purposes. Could many of the ministers know what is said of them self interest would lead them to refuse in every case. It should be taken as an insult by every minister of the Gospel of Christ to be asked to furnish his photograph, or to consent to its use, as a part of a patent medicine or any other advertisement.

In one instance the name of such a person was proposed for the pastor of one of the best churches in Methodism. A brother of high character and respectability, noted for his kindness when speaking of ministers, rose and said: "I hope this brother will not become our pastor." "Why?" said half a dozen voices. He did not reply, but spread before them a newspaper containing the photograph of the minister, in connection with three or four letters, one from himself interlarded with ascriptions of praise to the Deity for having led him to buy the —— pills. His name was not mentioned again.

We find the above in a well-known medical journal, and we suppose it is correctly credited to our esteemed contemporary with a backbone and a conscience, the *Christian Advocate*, of which the Rev. J. M. Buckley is the editor and Dr. De Puy assistant editor. In view of the fact that Dr. De Puy has figured as the strongest and most persistent public endorser of the Electropoise, and that Dr. Buckley has stated that he would not allow the *Christian Advocate* to accept the advertisement because it was a manifest humbug, we are safe in assuming that Dr. Buckley and not Dr. De Puy wrote the article.

That two men holding such radically different opinions, putting those opinions into practice, can work harmoniously together is one of the strongest possible proofs of the cementing influence of Christianity on men. The "tie that binds" was never put to severer test.

Every word which Dr. Buckley has said is as true as the Gospel which he preaches, and every word of condemnation heaped upon the Electropoise and its promoters by ELECTRICITY is equally true, and we await the opportunity of proving our charges in a court of law.

Every religious paper in America might well keep standing in a conspicuous place in its columns the words of Dr. Holmes: "Quackery hobbles along on two crutches; the one the superstition of women, the other the endorsements of clergymen."

As One Honest Man Sees It.

To the Editor of ELECTRICITY.

DEAR SIR: Thank you for your favor of the 30th ult., and for issues of November 21 and November 28 of ELECTRICITY. I enclose fifty cents in stamps and would be pleased to receive any subsequent issues in which you have pursued the subject further.

It would seem after your exposures, and in the absence of any reasonable defence as far as I have seen, that the religious press and other publications are, by continuing to advertise the Electropoise, but lending their influence and endorsement to a scheme which, if what you say be true—and it has every appearance of truth—can only cause serious loss if not harm to many of their confiding readers. So far as I can discover by actual use, my Electropoise is entirely inert and therefore useless as a remedial agent. Yours very respectfully,

BENSON VAN VLIET.

Vassar College, Poughkeepsie, N. Y.

THE NATIONAL SCHOOL OF ELECTRICITY.

To the Editor of ELECTRICITY.

DEAR SIR: Replying to your inquiry relating to National School of Electricity, I have no stock in that corporation and none was ever offered to me for the use of my name. I have read proof of all lessons, but have neither received nor expected compensation. Yours truly,

HENRY S. CARHART.

University of Michigan, Ann Arbor.

To the Editor of ELECTRICITY.

DEAR SIR: I have your esteemed letter of the 21st and take pleasure in replying. Stock was sent out to the various members of the faculty of the National School of Electricity, as I was informed, in order that the faculty should have some assurance that they might have a hand in the control of the management if it became advisable. This is a perfectly reasonable arrangement, and, as far as I know, the stock is not dividend-paying and has not been used as a "consideration" with which to induce men to become members of the faculty.

I fear you have been led to size up the questions relating to the National School of Electricity the wrong way, on account of errors made by your informants. Respectfully yours,

D. C. JACKSON.

University of Wisconsin, College of Mechanics and Engineering, Madison.

We are willing to await the judgment of the people who have paid their money into the treasury of the National School for instruction on the supposition that that instruction was the result of the combined thought and effort of the entire body of eminent men known as the "faculty," but who would like to be known as an "honorary faculty."

Meantime we have no criticism to offer against either Prof. Jackson or Prof. Carhart. They have done the work which they were supposed to do, and there is no deception chargeable to them.

But we renew the charge that the other names on this faculty are being used in a deceptive and unfair manner to induce students to pay their money for something which it is not even intended to give them.

We also renew the charge that stock was offered to various gentlemen in exchange for the use of their names; that one of the present members returned the stock at once as he did not intend doing anything to earn it; that one member demanded several weeks ago that his name be removed from the advertising matter, and that it had not been removed up to a few days ago.

Several members of the faculty have failed to reply to our request for information as to their acceptance or non-acceptance of a block of stock.

Our columns are still open for this interesting news.

The Annual Meeting of the Okonite Co., Ltd.

The annual ordinary general meeting was held by the Okonite Company, Ltd., at the New York office of the company, No. 13 Park Row, December 27, 1894, Mr. Edward Lyman Short presiding.

A large percentage of the stock was represented.

Reports from the heads of the several departments showed a good business transacted by the company during 1894, and substantial indications that the business of the new year just entered upon is to be still better.

The meeting adjourned after re-electing the auditors.

THE KIND OF MAN HE IS.

The following is a correct copy of a letter which has been in our possession for several months :

[COPY.]

BOSTON, Aug. 23, 1892.

DEAR SIR : The *New England Magazine*, a high-class magazine, gets for advertising tickets over the various railroads, and in some cases mileage. I have asked its manager, Mr. J. Myron Potter, to correspond with you with reference to disposing of some of these tickets to you for the use of your agents. He can furnish them to you at about 25 per cent. discount from regular rates. Mr. Coffin is quite *largely interested personally* in the magazine and I would esteem it a favor if you could use all the tickets possible. Yours truly,

M. F. WESTOVER.
(Private Secretary.)

Mr. Westover was, in 1892, Mr. Coffin's private secretary. To-day he is Secretary of the General Electric Company.

In estimating Mr. Coffin's size as a man it may be necessary for some of our readers to know that every publication accepting railroad transportation in exchange for advertising must sign an ironclad contract that the transportation will be used only by regular members of the staff.

Yet it was nothing new after all for Mr. Coffin to be a party to crooked transactions.

Contemptible Business Methods.

We are always willing to advertise our contemporaries whenever their merits seem to deserve it, and it has from the start been a cardinal principle with ELECTRICITY to give the *name* of the paper to which it refers when comments have been made either of a flattering or other nature. This having been our rule in the past, we shall not flinch now. Mr. W. J. Johnston has recently written a communication to advertisers in competing electrical journals one of which has come into our hands which we think deserves a wider publicity than was intended by its author. If there is anything more contemptible in the way of business methods than that displayed in this letter we do not know what it is. Such a letter is an insult to the honor and intelligence of those to whom it is sent, and we are glad to announce, on the best of authority, that several of those who have received it or similar communications from the same source have expressed their contempt and disgust by ordering their advertisements out of Mr. Johnston's paper at once.

We believe and hope that many others will do likewise, for a man who would resort to such methods and then brazenly attach his own signature to them is a a journalistic Breckinridge and cannot be touched by shame. The only way in which such moral lepers, or those so sadly afflicted with business strabismus, can be reached is through the pocketbook. It seems strange that electrical journalism should have sunk so low as to count among its would-be exponents a man so apparently lost to manhood and honor as the signer of this document. The letter is partly as follows :

"Dear Sir : You may like to know what advertisers think of the 'World.' I enclose opinions recently received from well-known manufacturers and others.

"*I have no desire to dictate how you shall conduct your business*—[The advertiser will appreciate this.—ED.]—nor to ask you to accept my views unless doing so seems to your advantage.

"A specialist, however, who has devoted two decades to the study of a particular subject may understand more about that particular thing than a busy manufacturer who has given little attention to the matter."

We interrupt here to inquire—but how about it supposing that particular matter happens to be the manufacturer's own business ?

The letter goes on :

"I think I know how electrical and street railway purchasers can be reached thoroughly and economically and without waste of effort.

"It may be a delicate subject--[It seems that he appreciates this fact, and we agree with him that it *is* an *exceedingly delicate* subject.—ED.]—but in addition to your $\frac{1}{4}$ page announcement in the 'World' you also have a 10" advertisement in the ——. [Here is mentioned the name of one of the best known electrical journals in the country. We presume that this name is changed whenever the circumstances require, so that we might fill in any name we chose and still be right.—ED.]

"How many do you imagine read the —— and not the 'World ?'

"Why should one pay over and over again to reach through other journals a few of the same readers he has already thoroughly covered ?"

This is certainly philanthropic on the face of it, but does anyone suppose that Johnston is saying this in order to save the advertiser money ? If he does he is very much mistaken; he does not want the advertiser to spend less money, but asks him to take his advertisement out of the journal referred to and give it all to him. He continues :

"Is it not better to do as so many others do—*invest the additional amount in more space* in paper number one, particularly as circulation considered the others charge him 5 times the rate he pays number one ?"

This language shows that Mr. Johnston is out of place on Broadway—it is the language and the method of Baxter street and the clothing precincts of the Bowery. But even the "puller-in" of those classic localities exercises some judgment in approaching his victim. It is clear therefore in what estimation Mr. Johnston holds those whom he thus addresses. It may be all right from his standpoint, but how do the recipients of his letters regard it ?

"Remember Puddinhead Wilson's remark—'Behold the fool saith put not all thine eggs in the one basket'—which is but a manner of saying, scatter your money and your attention; but the wise man says, put all your eggs in one basket and WATCH THAT BASKET.

"You have for years pursued the scattering method of advertising.

"If you will give the one basket and watch-that-basket method a fair trial during 1895, you will change your views radically on advertising."

It appears from this that W. J. Johnston and Puddinhead Wilson are one in philosophy, but does Mr. Johnston think his patrons are all Puddinhead Wilsons ? Evidently he does. The question is, how will his patrons regard this estimate ?

The whole thing looks very much as though Mr. Johnston is reduced to very great business straits if he finds himself compelled in order to keep going' to run around among the electrical public begging them not to patronize his competitors but to give all their patronage to him. Can a self-respecting advertiser patronize a man who would stoop to such methods ? Can he by his patronage assist this blot upon the otherwise fair name of electrical journalism to live ? Will he, by continuing his patronage, feed the cancer that is gnawing at the vitals of business honor ?

We fancy that those who follow Puddinhead Johnston's advice and put all their eggs in *his* basket will also follow that other philosopher's advice and "watch that basket" mighty closely.

Windmills have been used for driving motors for some time past; now it is proposed to reverse the arrangement and use an electro-motor to drive the machinery of a windmill. The owner of a windmill at the Ansgari Gate, Bremen, Germany, intends to use current from the town mains to drive his mill whenever there is not enough wind to work it in the usual way.

NEW YEAR GREETINGS.

Mr. Godfrey's House Warming.

Messrs. J. W. Godfrey, F. W. Harrington and J. B. Olsen, who have lately opened offices at 15 Cortlandt street for the Habirshaw Company, kept open house the last afternoon of the old year. The many friends of these gentlemen crowded the rooms for two hours presenting good wishes for the new venture; ELECTRICITY'S best go with the others.

The S. F. B. Morse Co., Western agents for Day's Kerite, remembered their friends with a small bottle of Old Coronet and a good cigar. We know the cigar was good, and have no reason to doubt that the Coronet *is* also good.

Warren & Lozier's Dinner.

On Monday night at 6, Messrs. Warren & Lozier gave a dinner to their employees and a few invited guests at the Maison Francais in Washington street.

There were thirty-five employees of the firm present and the affair was more than pleasantly successful. Among the invited guests present were Messrs. T. C. Martin and Mr. Joseph Barr. Letters of regret were read from Messrs. C. A. Coffin, S. Dana Greene, Capt. Eugene Griffin, Mr. W. J. Clarke, Mr. Thos. A. Edison and others.

Although one of the newer concerns in the business, it is evident that Messrs. Warren & Lozier are up to date. We trust they may have 100 employees at their next dinner. The custom is a good one and should be kept up.

Personal.

Mr. A. H. Reece, whose connection with the G. E. Company ended December 1, is now located in St. Louis as district agent for the Ft. Wayne Electric Corporation. Mr. Reece is familiar with that territory, is one of the old-time salesmen, with a record for getting business, and we predict for him and his company marked success.

Mr. James F. Kelly, formerly identified with the Edison interests for many years, and general manager of the wire department, succeeds Mr. James W. Godfrey in the New York Insulated Wire Company. Mr. Kelly has a host of friends who will be glad to see him hustling again, and who extend to him their good wishes.

Mr. Jefferson Young has been appointed manager of the New York offices of the Stilwell-Bierce & Smith-Vaile Co., of Dayton. Mr. Young is located at 112 Liberty street.

LEGAL NOTE.

Proceedings for the voluntary dissolution of the Standard Gas and Electric Light Company of Suffolk County, N. Y., have been taken in the Supreme Court, and Justice Andrews has appointed William D. B. Janes temporary receiver of the company. The application for the appointment of the receiver was made by Janes and Victor Cumberson, both directors in the company, which was organized in 1890 with a capital stock of $200,000. It is charged that the company has a number of judgments against it, which it cannot pay, and that it is insolvent.

Boston Notes.

The overseers and foremen employed in the factories of the General Electric Company at Lynn, Mass., will hold their annual banquet at the Revere House, Boston, January 26. On that occasion Prof. Elihu Thomson and the managing heads from the Schenectady works are expected to be present as guests.

There was a lively tussle on Federal street, Boston, a few days ago between the employees of the West End Railroad and those of the Union

Freight Railway, where the tracks of the two companies run side by side. The row took place as the outcome of an attempt of the West Side folks to clear their tracks by shoveling the snow on to their neighbor's tracks. With the aid of a snow plow and a locomotive the snow already piled up by shovel was quickly turned right back on to the West End tracks. This led to any amount of cursing of each other by the men, who nearly got to blows in their rage. Finally the snow was turned over a second time by the snow plow, after it had been shoveled back by the men, but instead of finding its way on to the tracks again it was piled up on the sidewalk to the great inconvenience and discomfort of the pedestrians.

The town of Blackstone, Mass., at a public meeting of taxpayers has just voted by a large majority to offer the Woonsocket Electric Light Company a contract to light the town at the rate of forty cents per night. If this offer is declined then it is reported the town will install a plant and do its own street lighting. The past year fifty cents per lamp of 2,000 C. P. to burn all night was paid.

The Dynamo-Electric Maintenance Company, an incorporated concern doing business in Boston at the John Hancock Building in repairing and guaranteeing the maintenance of dynamos and motors, has been brought to task by Insurance Commissioner Merrill. That official regards the business as of an insurance character, which is not permissible in Massachusetts. The company, however, contends that it is not an insurance business, that it simply proposes to keep in repair dynamo electric machines and other kinds of electrical apparatus, and by its contract excepts any reponsibility in case of fire, explosion, falling walls, damage by water or any other accidental cause. It is the usual and ordinary breaks and wear which result from running the apparatus that it contracts to make good. It claims that if its line of business is insurance then the physician who contracts to attend families by the year, the telegraph company that guarantees the delivery of a dispatch, the watchmaker who guarantees to keep a watch in repair for a year, the individual who contracts to keep a typewriter in working order for a specified time, the express company that makes itself responsible for packages—in fact, every individual or company that agrees to perform a service for a stated period for a certain sum—are in the insurance business. Under the advice of their counsel the company proposes to continue the business.

General News.

What is Going on in the Electrical World.

Cleburne, Tex.—An electric light plant is to be established here. The mayor says it will be in operation in sixty days.

Indianapolis.—The Jenney Electric Motor Company has decided to remain in Indianapolis and will erect new buildings and enlarge its plant.

Utica, N. Y.—The Utica Electric Light and Power Company reports the closing year's business the best it has had since starting, four years ago.

Norwich, Conn.—There is prospect of an electric railway between Norwich and New London next summer. Surveyors are now at work laying out the line.

Holbrook, Mass.—The Commercial Club has taken in hand the matter of lighting the town by electricity and have held consultations with an electrician on the subject.

Webb City, Mo.—At a special election held here last week to vote $15,000 in bonds to erect an electric light plant by the city, the proposition was carried by nearly five to one.

Allegheny, Pa.—The select council has passed a resolution awarding the contract for the new electric light plant to the Western Electric Company, whose bid was the lowest.

Capac, Mich.—The citizens of Capac are beginning to agitate the question of lighting up their streets by electricity and they desire to hear from reliable parties as to the probable cost of putting in a plant.

Guilford, Me.—A topic awakening interest in this place is the proposed trolley road from Guilford to Dover and Foxcroft, taking in Sangerville village, and it seems probable that the road will be built at an early day.

Wallingford, Conn.—A petition has been drawn up and addressed to the warden and burgesses of this borough requesting them to call an election to vote on the question of establishing an electric lighting plant.

Hartford, Conn.—Henry Green, the inventor of the Green incandescent lamp, has secured new patents covering a lamp that is now being made in this city in large numbers. Some twenty hands are employed at the works.

Sacramento, Cal.—The South Yuba Water Company have been granted a franchise to deliver 600 horse power of electrical energy in this city for lighting and other purposes, to be transmitted from their plant at Newcastle.

Bangor, Me.—The promoters of the electric road from this city to Old Town have discussed the matter fully in all its points. There seems to be no room for doubt that the building of the road will be commenced early in the spring.

Pensacola, Fla.—E. A. Sweet has surrendered his lease of the Pensacola Electric Light and Power Company and B. R. Pitt will hereafter manage the plant. Thos. C. Watson will have charge of the financial department of the business.

McKeesport, Pa.—A company to be known as the Crooked Run Electric Railway Company is being organized in this city. Samuel Bowman is at the head of the organization, which proposes to build an electric railway from this city to Irwin.

Hingham, Mass.—It is understood that the selectmen will grant a franchise for an electric railway to the promoters of the Hingham Electric Street Railway Company. The capital stock of the company will probably be increased to $100,000.

Creede, Col.—The Amethyst Electric Power and Light Company has sold all machinery, wires, etc., to F. D. Russell & Bro., of Denver, who have taken charge. The new company will extend the lines to Bachelor, Upper Creede and the mines.

New Haven, Conn.—Charles S. Merrick, receiver of the Ansonia Electric Company, has applied for an order empowering him to sell the plant, etc., of the company. The receiver holds such a course to be for the best interests of the creditors.

Sayville, N. Y.—Some of our enterprising citizens are about to organize a trolley railroad company to construct an electric railroad from Sayville, L. I., touching at Bohemia, Ronkonkoma, New Village, St. James and terminating at Port Jefferson.

Fond du Lac, Wis.—The plant and equipment of the Light, Power and Railway Company have been sold at sheriff's sale to Elihu Colman, who is understood to represent the First National Bank of Chicago, which holds a mortgage of $100,000 on the property.

Exeter, N. H.—A party of Chicago capitalists have been viewing the vicinity of Hampton beach, and are considering the advisability of connecting the towns of Hampton and Exeter with an electric railway. The citizens of Hampton are in favor of the project.

Salt Lake City, Utah.—The Citizens' Light Company of Salt Lake City has been incorporated by Charles Boettcher, of Denver, Col., for $500,000. The company will commence work at once, and are in the market for engines, boilers, wire, electrical machinery, etc.

Athens, Ga.—The Athens Gas and Electric Light Works, which for several years have been under the management of Dr. John A. Hunnicutt, of this city, have been leased to Messrs. W. A. Mallory and Lamar Lyndon, two energetic and capable young men of Athens.

Trenton, N. J.—The street car system of this city has passed into the hands of the syndicate recently formed with the intention of leasing it. Thomas C. Barr, of Newark, has been elected president of the new board of directors. Henry Moore, of Philadelphia, will be general manager.

La Crosse, Wis.—Some of our enterprising citizens have been trying to purchase a splendid water power at Neshonoc to be used in developing electric light for transmission to La Crosse or wherever there was market for it. The deal failed because the price could not be agreed on.

Wolcott, Col.—The Bennett Electric Placer Mining Company of Denver have erected a plant valued at $6,000 on the Grand River about eighteen miles from Wolcott. All the latest electrical appliances are employed for the purpose of saving the fine gold and for motive power.

Anderson, Ind.—Charles L. Henry of this city has secured a franchise for an electric street railway in Pendleton. Mr. Henry is operating for a company of Indianians, who announce that they will build an electric street railway from Indianapolis to Marion and one from Alexandria to Elwood.

Jacksonville, Fla.—The prospects are favorable for all of the street car lines now operated by mule power in Jacksonville to soon have electric cars running upon them. This has been the intention of the Jacksonville Street Railway Company for some time, and will be carried out as fast as practicable.

Albany, N. Y.—Mr. Parsons has introduced a bill in the Senate lowering the charges of the telephone companies in the various cities of the State. In New York he would have subscribers pay $78 a year, in Brooklyn $66 a year, in Buffalo, Rochester and Albany only $48 a year, and in other cities $36.

Connersville, Ind.—A company, headed by H. M. Miller, and incorporated under the name of the Connersville Gas and Electric Company, has purchased J. N. Huston's interest in the Connersville Gas Company for $100,000. The purchasing company thus acquires a monopoly of the gas and electricity of this city.

Brooklyn, N. Y.—Mayor Schieren has appointed a commission to inquire into the cause of the many trolley accidents that have occurred in Brooklyn and to suggest whatever remedies may appear to them practicable. The views of the commission will be put in the form of a report and submitted to the board of aldermen for their action.

Herkimer, N. Y.—The projected electric road between this village and Utica seems in a fair way of being built; interest in the scheme has been increased lately by the purchase by Messrs. Beckwith & Quackenbush of a controlling interest in the Frankfort and Ilion street railroad, which is to form a part of the proposed system.

Akron, O.—The Akron Street Railroad Company has filed a mortgage in favor of the Central Trust Company of New York, to secure twenty-year 6 per cent. bonds amounting to $600,000. The mortgage covers all the present electric lines the company owns in Akron. This assures the building of electric roads to Cleveland, Kent and Barberton, 57 miles in all.

Oshkosh, Wis.—The line of telegraph known as the Chicago, Milwaukee and Lake Superior line, extending from Milwaukee by way of Oshkosh, Appleton and Green Bay to Marquette, Mich., has been purchased outright by the Postal Telegraph and Cable Company. The Postal Company had been operating the line under a lease since it was built in 1886.

Newark, N. J.—The Electric Bell and Resistance Company, just incorporated here, carry on the manufacture and sale of a novel resistance material invented by William F. Atwood, of Orange, formerly a member of Edison's laboratory staff. His invention covers a new process of carbonizing cord and leaving it so tough that it can be insulated with cotton or silk braid just as wire is, and can be wound upon a bobbin.

York, Neb.—The plant of the York Gas and Electric Light Company has been sold at sheriff's sale for $5,205. The original cost of the plant was $12,000. It was knocked down to John R. Pierson, cashier of the City National Bank, who is supposed to represent the leading stockholders in the old company. It is understood that a new company will be organized immediately to place the plant, which has greatly depreciated, in first-class order.

Allentown, Pa.—The directors and stockholders of the Allentown and Lehigh Valley Traction Company have unanimously agreed to increase the capital stock from $1,500,000 to $4,000,000 and to increase the indebtedness from $750,000 to $2,000,000. New bonds amounting to $200,000 will be issued and secured by the entire properties of the companies, eleven in all, which will be used to pay off the entire indebtedness of the different companies.

Waterport, N.Y.—The Electric Light, Power and Railway Company have awarded a contract for the building and equipment of four miles of the Beecher single rail electric road between Waterford and Lakeside, Orleans County. In case it is a success it will be continued eventually to Batavia, about forty miles. The standard equipments of the road will be for forty miles an hour and a car is being designed to run 150 miles an hour. D. Bromley, of Waterport, is president of the company.

Oswego, N. Y.—The Board of Public Works has entered into a contract with the People's Electric Light and Power Company by which the streets will be lighted for the next five years with electric lights of 2,000 candle power. The city is to have 195 arc lights for the streets and 190 incandescent lamps for the public buildings, and as many more as the board may see fit to order from time to time. The price to be paid is $81 per light per year for arc lights and $3.65 per light per year for incandescents.

Davenport, Ia.—A local manufacturer has offered a suggestion which is meeting with favor here, and will probably lead to the organization of a company to carry out the project. He proposes the establishment of a steam and dynamo plant in connection with a large body of coal at a point not far from the city, and the generation of immense currents of electricity to be transmitted to Davenport and neighboring cities, and there used for lighting, manufacturing, street car service and otherwise as there might be demand for it.

Philadelphia.—The *Record* states that the owners of the E. M. Underground Railway System patents gave an interesting exhibition at their shops a few days ago. Inventor McLaughlin, George Lodge and Henry C. Webster conducted the tests, which were made with the model car over an intricate track system, so arranged that the car is tested in every possible way. The model, it is stated, worked perfectly, and the expert electricians, for whom the tests were made, expressed themselves as well satisfied.

Staten Island, N. Y.—The route of the Staten Island Interior Railroad Company's proposed road is circular, from St. George, at the ferry landing, through the villages of Tompkinsville and Stapleton, and, after dropping a spur to South Beach, it crosses the island to West Brighton, whence it returns to St. George. The distance is twelve miles. It is said the route extends through an area of over twenty square miles of the most attractive portion of Staten Island, hitherto inaccessible, and that ten cents paid in the ferry house at the Battery in New York will cover the fare on the road.

Denver, Col.—The Clear Creek Gold Mining and Water Company has been organized by New York, Philadelphia and Colorado capitalists to wrest from the bed of Clear Creek for thirteen miles above Golden the vast accumulation of gold supposed to have been deposited there through the ages, and to supply electrical power for the running of all sorts of machinery. Henry Levis, of Philadelphia, is the president. The company contemplates supplying power to run the street cars and all sorts of plants in this city by generating electricity many miles away. It is believed to be one of the most important enterprises ever undertaken in this State.

Charleston, S. C.—P. K. McCully, of Anderson, S. C., has lately visited this city in the interest of the projected electric railway through the Blue Ridge from the coal fields of the West. Mr. McCully in describing the route said the road would run from the Jellico coal fields to Knoxville, Tenn., thence through the Rabun Gap to Anderson, and finally seek the best and most accessible port on the South Carolina coast. Some of the promoters of the enterprise favor making Port Royal its eastern terminus, while others wish to see the new road enter Charleston. The new line would form the shortest possible route between the Carolina coast and the West, reducing the distance to the Mississippi Valley from Charleston by at least 200 miles.

Worcester, Mass.—The Worcester Electric Power Company has recently changed hands. The new directors are: M. F. Rynne, of Springfield, president; E. F. Carpenter, of Concord, N. H., treasurer and general manager; H. J. Odell, of Concord, N. H.; H. W. Ranney, of Concord, N. H., and T. B. Dunn, of Gardner. The superintendent is John J. Welch. The company has a capital of $100,000 common and $100,000 preferred stock, and it is said proposes to do business under the charter of the old corporation organized by H. H. Bigelow before the institution of the State Gas and Electric Light Commission, and expects under it to be able to do a general heating and electric lighting business. It is agent for the Central Electric Heating Company of New York City.

San Antonio, Tex.—The *Express* has a long article detailing some of the installation work of the Fort Wayne Electric Corporation in Texas, and says: "The Fort Wayne Electric Corporation of Fort Wayne, Ind., is one of the giants among the giant institutions of America, and that its San Antonio office is the most popular and best known headquarters in Texas is naturally a matter for prominent exploit in this issue, it being one of the great institutions that have been the making of the 'Empire State.' The liberality and usefulness of this corporation have indeed been far-reaching in Texas. The State agency is located at San Antonio, with office at 207 Losoya street, and the agent is Mr. Edward J. O'Beirne, than whom there are few more esteemed or better known men in the electrical circles of the Southwest."

Albany, N. Y.—The council committee on applications to the Legislature will hold a meeting on January 10 to deliberate upon the project of having the city invest in an electric light plant to supply its own lights.—An open competitive examination for the positions of house electrician and dynamo tender in the hospitals of the State will be held by the State Civil Service Commission at Albany, Wednesday, January 16, at 10 A. M. The house electrician must be competent to take full charge of the practical operation of the electrical plant, and the dynamo tender must be competent to have charge of the running of the dynamo. The examination will be confined to the technical knowledge requisite for the performance of these duties. Candidates must be between the ages of 21 and 50 years, and resident citizens of the State of New York at the date of application.

Kingston, N. Y.—Efforts are being made here to form a company to manufacture a varied line of patented electrical articles which are in great demand. One of the men interested says: "The business will be managed by four men who are at the heads of departments in one of the largest electrical concerns in this country. They are all competent men and at present are drawing large salaries. One of them has developed the arc light to its present state of perfection, another has patented a suspending electric motor for which he has already been guaranteed an order for 500, and besides these the men hold many valuable patents in the electrical line. They represent the brains of the concern they are employed by and if a factory is established here will sign a contract to give the company the full benefit of all their patents and any new ones they may devise. They propose that a company be organized in this city with a capital of $250,000, of which stock they will take 50 per cent., the remainder to be raised here."

A Westinghouse Souvenir.

The Westinghouse Company have issued a handsomely printed souvenir of the formal opening of the Brinton Works by the reception tendered to the Grand Army delegates by the citizens of Pittsburg in September. It is accompanied by a colored map of the works.

The Washington Carbon Company.

The Washington Carbon Company of Pittsburg have had reason in the past two weeks to know that the public appreciates their enterprise in being the first American carbon company to produce a Cored Carbon equal to the best made abroad. Central station men have been quick to see the advantages of buying at home when equally high-class goods can be made here.

The Washington Company are in the front rank, and are pushing in every direction to give their customers the best in every line.

Continued Prosperity of the Mather Company.

The Mather Electric Company of Manchester, Conn., report a very bright outlook for the year 1895, and in fact the company has at no time during its existence had so many orders on its books as it has to-day. The company now have in course of construction in their works at Manchester the following apparatus on orders: Five 200 K. W., twelve 100 K. W., one 80 K. W., eight 60 K. W., three 45 K. W., three 30 K. W. belted generators of their new multipolar type; also three 100 K. W., one 80 K. W., two 65 K. W., two 50 K. W. and one 30 K. W. direct connected generators of their new multipolar type, and also thirty-one ring type dynamos and seventy Manchester motors of various sizes.

Notwithstanding the extensive additions in the way of new tools and facilities which have been added recently to their Manchester plant, the company have found it necessary for the last two months to operate their entire plant twenty-four hours a day with two shifts of men, but so far have been unable to keep up with their orders.

The first three days of January the Mather Company closed contracts for ten generators, aggregating 1,300 kilowatts, for railway and power work.

INCORPORATIONS.

The Knoxville Electric Company, Knoxville, Ia.—to operate an electric light and power plant at Knoxville. Capital stock, $20,000. Promoters: J. H. Auld, W. O. Robinson, J. S. Bellamy, Knoxville.

The New Martinsville and Mannington Telephone Company, New Martinsville, W. Va.—to maintain and conduct electric telephone lines, underground, overhead, etc., use and sell all electrical apparatus, etc. Capital stock, $20,000. Promoters: Amos Jollefer, Uniontown, W. Va; Jno. C. Poe, Sincerity, W. Va.; O. M. Crow, Littleton, W. Va.

The Columbus Illuminating Company, Columbus, Ohio—to establish and operate electric light, heat and power plants. Capital stock, $25,000. Promoters: R. J. M. Danley, Columbus; W. B. Park, W. A. Hardesty.

The Anthony Company, Cincinnati, Ohio—to manufacture and deal in electrical and magnetic appliances, construct and operate telephone lines, etc. Capital stock, $200,000. Promoters: Mark O. Anthony, Louis Feder, Max Silberberg.

The California Electric Light and Power Company, California, Mo.—to manufacture and operate an electric light and power plant. Capital stock, $6,000. Promoters: E. B. Crane, W. H. Mengel, Henry Herfurth, J. P. Cray.

The Nashold Cleat Company, Chicago, Ill.—to manufacture and sell electrical appliances and supplies, and buy and sell goods and patents relating thereto. Capital stock, $10,000. Promoters: Elias Nashold, Martin W. Cresey, Luther E. Ellison.

The W. J. Davis Electric Company, Pittsfield, Mass.—to manufacture electric apparatus, electric and gas fixtures and other mechanical apparatus. Capital stock, $6,000. Promoters: Jacob Crinlich, Wm. P. Wood, W. J. Davis, Jno. White.

The Potts Machinery Supply Company, Columbus, Ohio—to deal in and manufacture water, gas, steam, oil, air and electric specialties. Capital stock, $10,000. Promoters: Wm. B. Potts, Walter B. Page, I. N. Hansbrough.

The Acme Electric Company, East Palestine, Ohio—to manufacture and furnish electric light, heat and power. Capital stock, $10,000. Promoters: Geo. E. Sebring, R. N. Chamberlin, D. H. Mackintosh.

The Treleaven Optical Company, Chicago, Ill.—to manufacture, buy, sell and deal in optical, photographic and electrical goods, etc. Capital stock, $30,000. Promoters: Walter N. Treleaven, Geo. M. Stannard, Thos. S. Jackson.

The Boston Switch Manufacturing Company, Portland, Me.—to manufacture and deal in electrical apparatus. Capital stock, $1,000. Promoters: Wm. L Haven, Robert W. Frost, of Boston, Mass.; Chas. H. Clark, Cambridge, Mass.

The Parkesburg Electric Light, Heat and Power Company, Parkesburg, Pa.—to manufacture and supply light, heat and power by electricity. Capital stock, $10,000. Promoters: Horace A. Beale, Thos. C. Young, Enoch P. Moore, Parkesburg.

The Charles F. Burns Company, Rochester, N. Y.—to manufacture and sell all manner of supplies for electrical railways. Capital stock, $5,000. Promoters: C. F. Burns, E. M. Higgins, Alfred Creen, of Rochester.

The Scott County Long Distance Telephone Company, at Indianapolis, Ind. Capital stock, $500. Incorporators W. E. Leonard, of Chicago, and others.

The Rushville Electric Light Company, Rushville, Ill. Capital stock, $12,500. Incorporators; C. W. Wainman, Charles B. Griffith, and others.

The Fulton Electric Light and Power Company, Fulton, Ill. Capital stock, $20,000. Incorporators: C. C. McMahon, H. S. Remer and Ed. Wyatt.

The Buffalo Electric Transit Company, Buffalo, N. Y.—to construct and maintain a line or lines of electric telegraph and telephone, connecting Buffalo with other cities of the State. Capital, $300. Directors: Ira C. Brown, C. M. Daniels, F. P. Jones, William W. Read, Thomas B. McMahon, Charles Olshel, Byron J. Tillman, William Wilhelm and Earl J. Woodworth, of Buffalo.

The Nyack Traction Company—to build and operate a street surface road for 7½ miles from West Nyack through Nyack, South Nyack and Piermont, Rockland County, N. Y. Capital stock, $75,000. Directors: F. R. Bain, Samuel H. Brown, F. F. Lawlor, Edward S. Atwater, Isaac W. Sherrill, William Schickle and G. O. House, of Poughkeepsie; A. S. Tompkins, of Nyack, and F. P. Demarest, of West Nyack.

Woven Wire Brushes.

The Belknap Motor Company of Portland, Me., are the patentees and manufacturers of the best Woven Wire Brush on the market.—[*Adv.*

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